

# Final Exam Study Sesh for ADM4754

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**Yellow highlighter= highlighter**

**Green highlighter= example**

**Baby blue highlighter= Formula**

## **Chapter 13- International Capital Market Equilibrium**

*"A strategic allocation to international securities may enhance a portfolio's risk-adjusted returns, provide portfolio diversification, and offer opportunities to seek higher performance. And when those securities are not hedged, international investing can offer pure exposure to local equity and currency returns."*

*Blackrock (iShares website)*

### **The two risks of investing abroad**

- Returns of the international asset in its local currency
- Variations in the value of the foreign currency relative to investor's currency
- Return of investment = return of asset + return of currency
- $R(t+1, \$) = r(t+1, £) + s(t+1) + r(t+1, £) * s(t+1)$

**Example: \$10 Million to invest**

**-Convert to £:  $\$10M / (\$1.60/£) = £6.25M$**

**-Invests in British Equity for 1 yr**

- $R(t+1, \$) = r(t+1, £) + s(t+1) + r(t+1, £) * s(t+1)$
- Asset ↑ 10%, currency ↑ 10%
  - $10\% + 10\% + 1\% = 21\%$  (\$11M)
- Asset ↑ 10%, currency ↓ 10% (or reverse)
  - $10\% - 10\% - 1\% = -1\%$  (\$9.9M)
- Asset ↓ 10%, currency ↓ 10%
  - $-10\% - 10\% + 1\% = -19\%$  (\$8.1M)

	Means			Volatilities		
	Market Return	Currency Return	Dollar Return	Market Return	Currency Return	Dollar Return
United States	11.52%	0.00%	11.52%	15.58%	0.00%	15.58%
Canada	10.72%	0.54%	11.73%	17.00%	6.73%	20.64%
Japan	5.21%	4.10%	9.28%	19.22%	11.76%	22.51%
United Kingdom	12.98%	-0.65%	12.17%	16.45%	10.50%	18.91%
France	12.56%	-0.21%	12.14%	20.12%	11.00%	21.93%
Germany	11.00%	1.12%	11.91%	21.13%	11.21%	23.06%
Italy	14.26%	-1.48%	12.51%	24.35%	10.89%	25.59%

Notes: The original data are monthly total equity returns (including capital gains and dividends) taken from Morgan Stanley Capital International (MSCI) for the period January 1980 to August 2010. Means and volatilities are expressed as annualized percentage rates by multiplying monthly means by 12 and monthly volatilities by  $\sqrt{12}$ . The market return is in foreign currency; the currency return is the change in the value of the foreign currency relative to the dollar.

$$\text{Covariance}_{AB} = \text{Correlation} * \text{Vol}_A * \text{Vol}_B$$

- Correlation =  $\rho$
- If  $\rho < 1$ , there is a diversification benefit

Country	Correlation
Canada	0.42
Japan	-0.02
United Kingdom	-0.09
France	-0.10
Germany	-0.09
Italy	-0.09

Notes: The original monthly data are taken from MSCI and cover the period January 1980 to August 2010.

- Sharpe Ratios
  - Measured as the average excess return relative to the volatility of the return
  - Sharpe Ratio =  $(E[r] - r_f) / \text{Vol}[r]$

Country	Sharpe Ratio
United States	0.42
Canada	0.33
Japan	0.19
United Kingdom	0.38
France	0.33
Germany	0.30
Italy	0.29

*Note:* Ratios are computed as the average return from Exhibit 13.1 minus 5% (our estimate for the sample risk-free rate) divided by the volatilities in Exhibit 13.1.

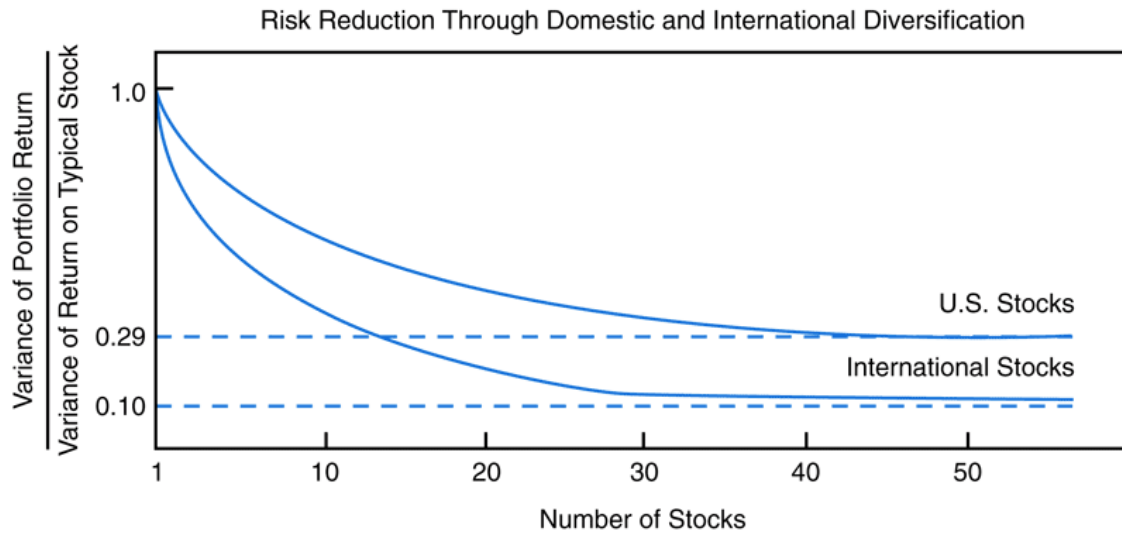
- **Systematic risk** – the risk associated with an asset’s return arising from the covariance of the return with the return on a large, well-diversified portfolio
  - Correlation – how two assets covary with each other [-1, 1]
  - The part of risk that commands a risk premium
- **Unsystematic (Idiosyncratic) risk** – the risk that is attributed to the individual asset and can be diversified away
- **Capital Asset Pricing Model (CAPM)** – theory created by William Sharpe (he won the Nobel Prize in Economics in 90 for this) – determines an asset’s systematic risk

$$- E(r_{\text{asset}}) = r_f + \beta(r_m - r_f)$$

$$B = \text{Covariance}(r_{\text{asset}}, r_m) / \text{Variance}(r_m)$$

Def. from Ch 7.

- Risk reduction through international diversification
  - Nonsystematic variance (~ 60% - 75% of variance in firm’s return)
  - Systematic variance or market variance
  - Idiosyncratic variance changes over time



*Note:* Author's calculations with the assistance of Xiaoyan Zhang. The sample period is 1999 to 2008.

- International return correlations
- What drives correlation of returns?
  - Trade
  - Geographic proximity
  - Industrial structure
  - Irrational investors (i.e., contagion)
- Asymmetric correlations?
  - International diversification benefits evaporate when you need them the most - in bear markets
    - Investors are still better off if they diversify internationally though!!!
    - Bear market- A market in which its securities values are falling and are made worse by negative speculation.

	AT	BE	CA	DK	FR	DE	HK	IT	JP	NL	NO	SG	SP	SE	CH	UK	US	GR	PT	IE	FI	NZ	
AU	0.40	0.46	0.67	0.43	0.50	0.48	0.51	0.39	0.39	0.55	0.60	0.56	0.52	0.54	0.48	0.62	0.56	0.39	0.45	0.57	0.52	0.73	
AT		0.59	0.43	0.49	0.58	0.65	0.35	0.46	0.31	0.59	0.54	0.37	0.50	0.43	0.58	0.51	0.38	0.53	0.55	0.58	0.38	0.50	
BE			0.50	0.61	0.74	0.70	0.36	0.54	0.42	0.75	0.64	0.42	0.57	0.53	0.67	0.64	0.56	0.50	0.59	0.66	0.40	0.42	
CA				0.53	0.56	0.53	0.52	0.47	0.40	0.64	0.63	0.57	0.50	0.56	0.52	0.64	0.75	0.36	0.47	0.52	0.55	0.53	
DK					0.59	0.62	0.35	0.52	0.41	0.65	0.61	0.41	0.54	0.56	0.58	0.57	0.52	0.42	0.56	0.62	0.48	0.41	
FR						0.78	0.38	0.61	0.45	0.76	0.64	0.40	0.65	0.61	0.68	0.67	0.62	0.51	0.61	0.60	0.55	0.45	
DE							0.42	0.57	0.38	0.79	0.60	0.43	0.63	0.66	0.72	0.61	0.60	0.50	0.59	0.63	0.57	0.46	
HK								0.36	0.31	0.51	0.47	0.63	0.43	0.45	0.39	0.52	0.46	0.29	0.41	0.41	0.41	0.46	
IT									0.42	0.57	0.45	0.34	0.60	0.55	0.47	0.51	0.44	0.49	0.57	0.52	0.54	0.43	
JP										0.46	0.37	0.36	0.46	0.43	0.45	0.47	0.37	0.23	0.37	0.47	0.39	0.41	
NL											0.70	0.52	0.62	0.66	0.74	0.75	0.71	0.49	0.64	0.70	0.56	0.55	
NO												0.52	0.53	0.61	0.58	0.66	0.58	0.44	0.54	0.60	0.53	0.54	
SG													0.42	0.49	0.41	0.53	0.58	0.33	0.39	0.47	0.42	0.55	
SP														0.62	0.56	0.60	0.53	0.54	0.71	0.62	0.54	0.55	
SE															0.58	0.60	0.60	0.44	0.59	0.59	0.67	0.57	
CH																0.65	0.58	0.42	0.58	0.56	0.43	0.49	
UK																	0.66	0.43	0.57	0.71	0.55	0.53	
US																		0.37	0.47	0.64	0.58	0.48	
GR																			0.57	0.44	0.33	0.36	
PT																					0.54	0.44	0.48
IE																						0.48	0.47
FI																							0.44

Notes: The countries are Australia (AU), Austria (AT), Belgium (BE), Canada (CA), Denmark (DK), France (FR), Germany (DE), Hong Kong (HK), Italy (IT), Japan (JP), the Netherlands (NL), Norway (NO), Singapore (SG), Spain (SP), Sweden (SE), Switzerland (CH), the United Kingdom (UK), the United States (US), Greece (GR), Portugal (PT), Ireland (IE), Finland (FI), and New Zealand (NZ). The data are monthly dollar returns from MSCI for the period from January 1980 to August 2010, although for some countries, the sample starts later.

## Matrix in-between developed countries.

Country	Correlation
Canada	0.75
Japan	0.37
United Kingdom	0.66
France	0.61
Germany	0.60
Italy	0.43

Notes: All returns have been converted to U.S. dollars. The original monthly data are taken from MSCI.

- The effect of international diversification on Sharpe Ratios
  - Portfolio risk and return
  - When does international diversification improve the Sharpe ratio?
    - $\rho < 1$ ; the lower the better
  - Investment hurdle rates – lowest possible expected return that allows for an improvement in the Sharpe ratio when they invest in that foreign market.

$$\text{Hurdle rate} = r_f + \rho \frac{E[r] - r_f}{\text{Vol}[r]} \text{Vol}[r^*]$$

Country	E[r] = 10%	E[r] = 12%
Canada	9.96%	11.94%
Japan	7.67%	8.74%
United Kingdom	9.01%	10.61%
France	9.32%	11.05%
Germany	9.41%	11.17%
Italy	8.57%	9.99%

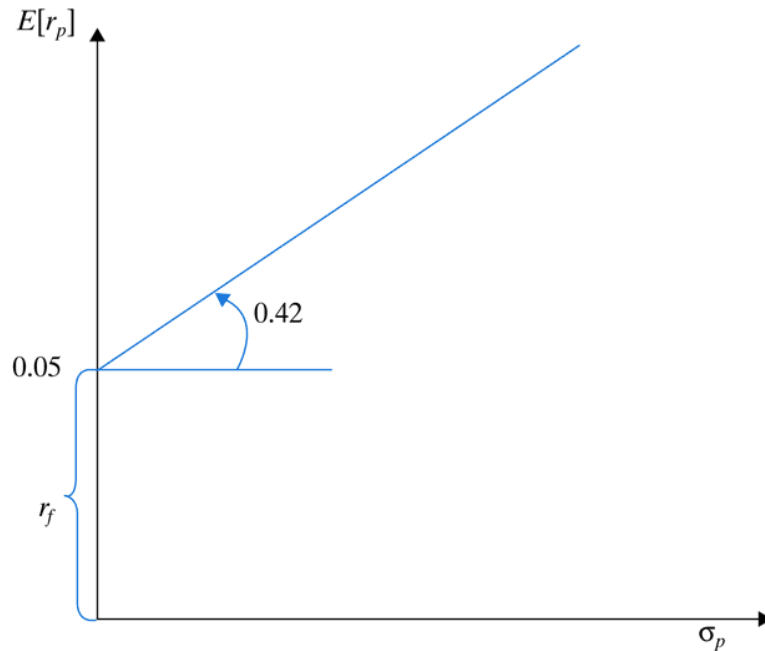
Notes: The hurdle rate equals  $r_f + \rho \frac{E[r] - r_f}{\text{Vol}[r]} \text{Vol}[r^*]$ . The correlation number is taken from Exhibit 13.6; the volatility numbers (in dollars) are taken from Exhibit 13.1 (both for the United States and the foreign country);  $r_f$  is set at 5%; and  $E[r]$  is the U.S. expected return specified on top of the two columns. Data are from MSCI, and the sample is from January 1980 to August 2010.

- **Optimal portfolio:**

- A portfolio that maximizes the utility function of an investor
  - Utility =  $E[r_p] - (A/2) \cdot \sigma_p^2$
  - where A is your risk aversion (higher is more risk averse)

- **The Case of One Risky Asset**

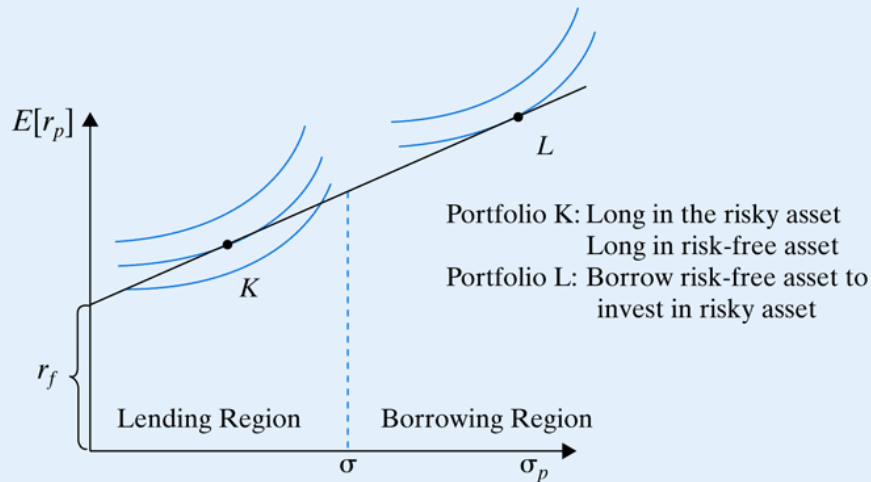
- Capital allocation line (CAL)
  - $R_p = w \cdot r + (1-w) \cdot r_f = r_f + w \cdot (r - r_f)$
  - $E[r_p] = r_f + [(E[r] - r_f) / \sigma] / \sigma_p$



Notes: The vertical axis shows the expected return, and the horizontal axis is the standard deviation of the portfolio. The line is the capital allocation line of feasible risk–expected return patterns. It emanates at the risk-free rate (5% in this example) and slopes upward with the Sharpe ratio of the risky asset,  $\frac{E(r) - r_f}{\sigma}$ , as its slope.

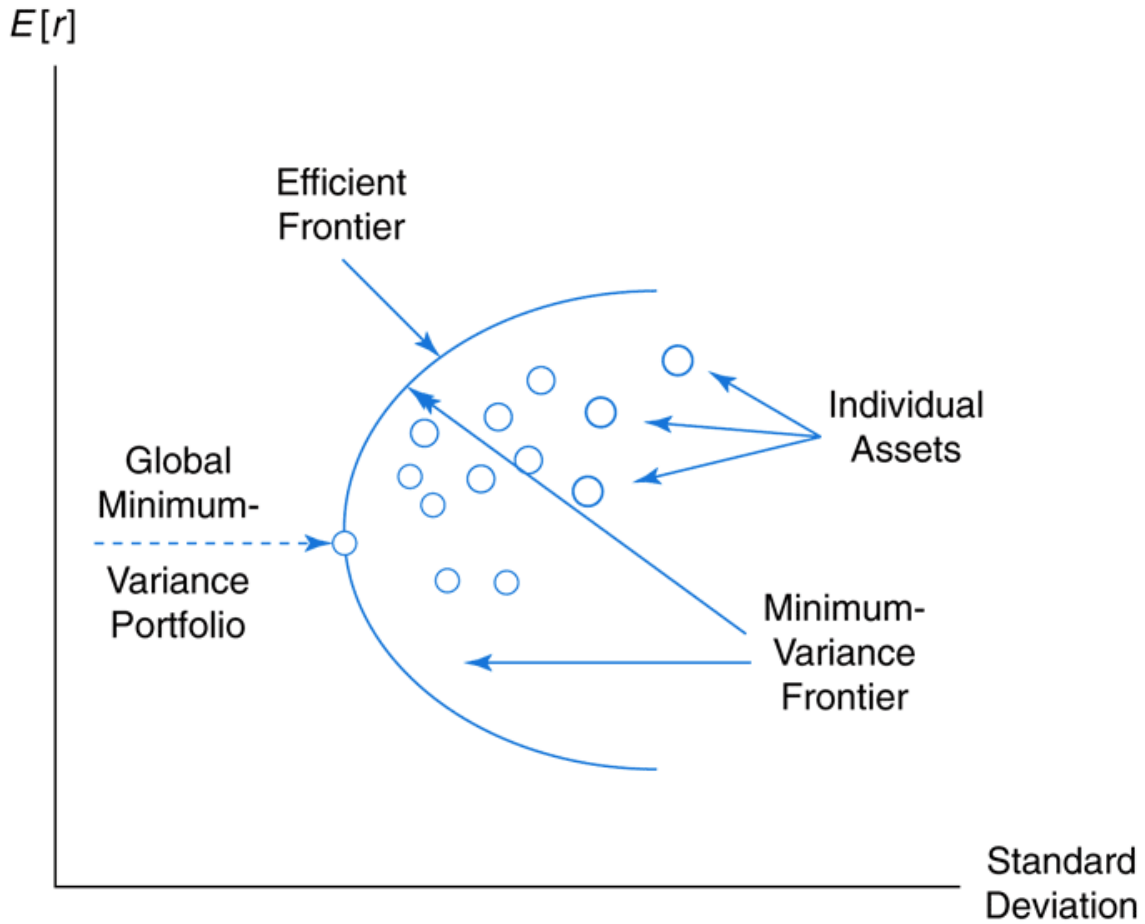
- Formula for optimal weight for the risky asset, which comes from a maximization problem:  $(E[r] - r_f) / A\sigma^2$
- $E[r_p] = r_f + [(E[r] - r_f) / \sigma] / \sigma_p$
- Different preferences for risk (low A=low risk aversion)
- Notice – low risk aversion results in more than 100% weight on risky asset!

A	W*	E[r <sub>p</sub> ]	σ <sub>p</sub>
1	2.69	22.51%	41.85%
2	1.34	13.76%	20.92%
3	0.90	10.84%	13.95%
4	0.67	9.38%	10.46%

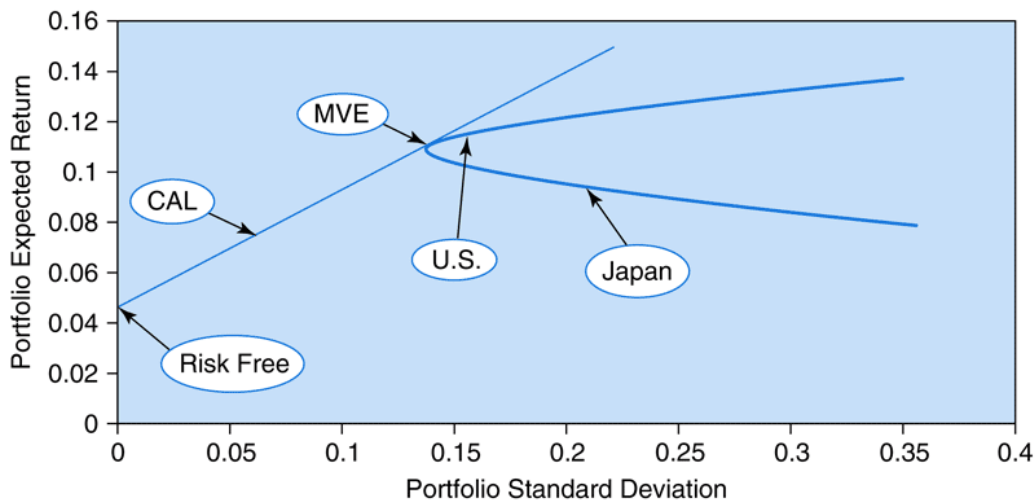


*Note:* Investors with different preferences toward risk and return invest in different portfolios, represented by different points on the capital allocation line.

- The Mean Standard Deviation Frontier
  - Once we add risky assets to the mix, things get very complicated very fast
  - Harry Markowitz (1952) – Nobel Prize in 1990!
  - To simplify we need to get rid of portfolios that aren't efficient using a minimum variance approach, i.e., how much risk are we willing to accept for a given level of return?
    - Minimize variance given the weights add up to one and the returns add to our target return
    - **Efficient frontier**



### Finding the MVE portfolio



*Notes:* We form the mean–standard deviation frontier from two assets. The U.S. portfolio has a mean return of 11.52% and a standard deviation of 15.58%. The Japanese portfolio has a mean return of 9.28% and a standard deviation of 22.51%. The correlation between the two returns is 0.37. The mean-variance-efficient portfolio dominates either individual portfolio.

La pente de la fonction CAL est égale au ratio Sharpe.

- Capital Asset Pricing Model (CAPM) – Sharpe (1964); Lintner (1965); and Mossin (1966) →  $E(r_j) = r_f + \beta_{jm} [E(r_m) - r_f]$ 
  - All investors hold the same portfolio for risky assets – the market portfolio
  - The market portfolio contains all securities at their respective market-valued weight
  - The market risk premium depends on the average risk aversion of its participants
  - The risk premium on an individual security depends on its covariance with the market portfolio
- Applications of CAPM
  - Evaluate fund managers
  - Motivated the creation of index funds
  - Provides starting point for calculating expected returns and costs of capital

- Interpreting the CAPM

- The CAPM equilibrium
  - Equity beta – a measure of systematic risk
    - $\text{Cov}(r_e, r_m) / \text{Var}(r_m)$
    - Positive beta contributes to portfolio variance
    - Negative beta reduces portfolio variance
  - **The risk premium on the market** – how much the market compensates investors for systematic risk
  - Individual expected returns and role of beta – if no correlation with market (Beta = 0) then the expected return would be equal to the risk-free rate because the market won't compensate investors this uncertainty

- Domestic versus world CAPMs

- Domestic CAPM – “market” is the aggregate asset holdings of all investors in domestic country
  - Assumes investors only hold domestic assets
- World CAPM
  - Makes more sense given the prevalence of international diversification

- Problematic given deviations from PPP and fluctuations of real exchange rates.

## **The CAPM**

- Recipe for the cost of equity capital
  1. Get data on the market portfolio return, the equity returns on security  $j$ , and the T-bill interest rate ( $r_f$ )
  2. Determine the market risk premium/prime du marcher – the expected excess return on the market portfolio [ $E(r_m) - r_f$ ]
  3. Obtain an estimate of  $\beta$
  4. Compute the expected return on security  $j$
$$E(r_j) = r_f + \beta_{jm} [E(r_m) - r_f].$$

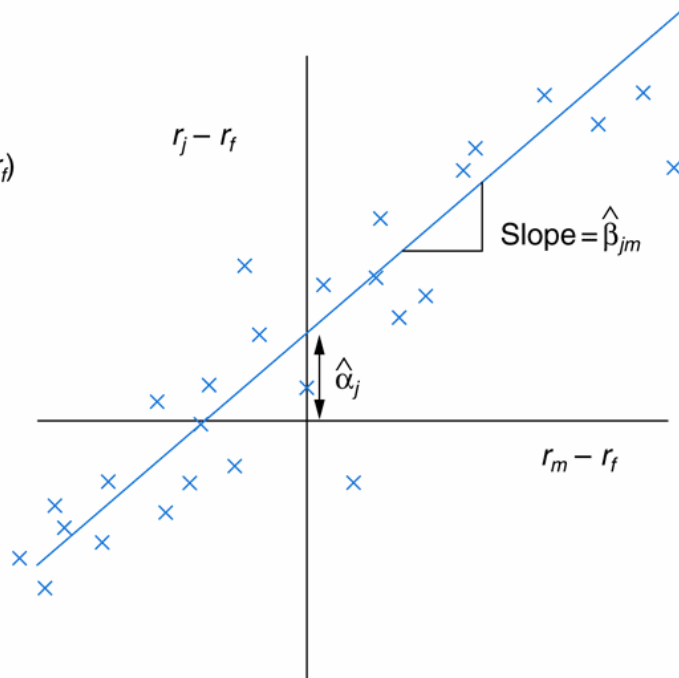
- The Benchmark Problem
  - **The market portfolio** – the value-weighted return on all assets that are available for investors to purchase
    - How does one get this data??
  - World market proxies
    - Morgan Stanley Capital International (MSCI) Index
    - Financial Times Actuaries (FTA) Index
  - Getting the benchmark wrong

### **\*Beta estimation\*??**

- Slope of regression line

Regression Line:

$$r_j - r_f = \hat{\alpha}_j + \hat{\beta}_{jm}(r_m - r_f)$$



Note: The CAPM implies  $\hat{\alpha}_j = 0$ . The x's represent a combination of the excess return on the  $j$ -th asset and the excess return on the market portfolio.

## Risk premiums on the market.

Country	Arithmetic Mean	Standard Deviation
Australia	8.49	17.00
Belgium	4.99	23.06
Canada	5.88	16.71
Denmark	4.51	19.85
France	9.27	24.19
Germany <sup>a</sup>	9.07	33.49
Ireland	5.98	20.33
Italy	10.46	32.09
Japan	9.84	27.82
Netherlands	6.61	22.36
Norway	5.70	25.90
South Africa	8.25	22.09
Spain	5.46	21.45
Sweden	7.98	22.09
Switzerland	5.29	18.79
United Kingdom	6.14	19.84
United States	7.41	19.64
<b>Average</b>	<b>7.14</b>	<b>22.75</b>
<b>World, excluding United States</b>	<b>5.93</b>	<b>19.33</b>
<b>World</b>	<b>6.07</b>	<b>16.65</b>

Notes: Data from Dimson, Marsh, and Staunton (2006). The mean column reports the average return on equity in percentage per annum over and above a risk-free return for the period 1900 to 2005. The standard deviation column reports the annual standard deviation of these excess returns.

<sup>a</sup>Germany values omit 1922 to 1923.

- **Investing in Emerging Markets**

- Returns vary between 5.78 for Jordan and 34% for Brazil!
- Volatility varies as well, from as low as 30% to as high as 59% (Turkey)
- Many opportunities for diversification
- Investment barriers – in early 1990s, many emerging markets disallowed foreign investment
  - Korea – foreign investment < 10%
  - Barriers can keep diversification benefits from being realized (Bekaert and Urias, 1996; 1999)

	Average Market Return	Volatility	Correlation with U.S. Returns	Correlation with Japanese Returns	Correlation with U.K. Returns	Correlation with German Returns
Argentina	31.07	55.06	0.29	0.08	0.20	0.19
Brazil	34.00	52.77	0.40	0.29	0.35	0.32
Chile	21.85	24.61	0.45	0.20	0.36	0.35
China	6.93	37.32	0.47	0.24	0.43	0.40
Colombia	23.36	32.72	0.31	0.22	0.36	0.35
Czech Republic	18.26	29.73	0.41	0.32	0.49	0.51
Egypt	23.30	33.53	0.35	0.31	0.37	0.36
Hungary	22.23	38.27	0.60	0.36	0.61	0.61
India	16.12	31.29	0.42	0.34	0.42	0.44
Indonesia	24.32	52.42	0.33	0.19	0.24	0.30
Israel	10.60	24.61	0.54	0.25	0.48	0.52
Jordan	5.78	18.74	0.19	0.15	0.20	0.16
Korea	14.54	38.94	0.43	0.49	0.39	0.34
Malaysia	13.19	29.56	0.36	0.28	0.37	0.37
Mexico	25.32	32.19	0.57	0.32	0.42	0.43
Morocco	14.73	19.59	0.14	0.16	0.25	0.25
Pakistan	13.12	39.33	0.13	0.03	0.18	0.12
Peru	24.98	33.13	0.36	0.37	0.38	0.40
Philippines	12.75	32.20	0.41	0.25	0.32	0.34
Poland	26.31	50.49	0.43	0.35	0.43	0.43
Russia	31.62	57.17	0.48	0.38	0.49	0.37
South Africa	16.61	27.96	0.55	0.53	0.58	0.58
Sri Lanka	15.54	37.99	0.18	0.21	0.28	0.17
Taiwan	13.14	37.44	0.36	0.28	0.28	0.37
Thailand	15.90	38.96	0.46	0.36	0.37	0.39
Turkey	29.07	58.93	0.33	0.19	0.31	0.38
EM Index	16.14	24.21	0.66	0.47	0.59	0.59

*Notes:* For most emerging markets, the monthly data run from January 1988 to August 2010. All returns are in U.S. dollars. The last line reports characteristics for returns on the Emerging Market Index, a value-weighted average of all 26 country indexes.

- The cost of capital in integrated and segmented markets
  - Segmented markets – expected (and average) returns should be related to the variance of returns rather than to the covariance with the world market return
  - **Equity market liberalizations – the allowance of inward and outward foreign equity investment**

- Real interest rate should fall since residents are now free to borrow and lend internationally
  - Equities will be priced based on their covariance with the return on world markets
  - More sensitivity to world events
- Segmentation and integration over time
  - **Integration barriers** – legal, information asymmetry and emerging-market-specific risks
  - Determining market segmentation extremely difficult
  - A model of time-varying market integration
    - Integrated markets
  - The practical implications of segmentation and time-varying integration
    - Cannot use historical discount rates
    - Look at firm as “project” in world portfolio
- Home bias and its implications
  - Home bias
    - Local investors hold a disproportionately large share of local assets compared to global assets
  - Implications for pricing – is International CAPM useless then?
  - Time-varying correlations – in general increasing over time (except Japan before 1999)

	Raw Home Bias		Normalized Home Bias	
Least Home Biased	United States	0.386	Netherlands	0.468
	Netherlands	0.457	Norway	0.567
	Norway	0.565	Austria	0.574
	Austria	0.573	Denmark	0.630
	United Kingdom	0.626	Sweden	0.639
	Denmark	0.627	Belgium	0.664
	Sweden	0.633	New Zealand	0.687
	Belgium	0.659	Canada	0.689
	Canada	0.669	United Kingdom	0.689
	New Zealand	0.686	Argentina	0.720
	Singapore	0.717	Singapore	0.721
	Argentina	0.719	United States	0.727
	France	0.724	Finland	0.740
	Finland	0.736	France	0.757
	Italy	0.755	Italy	0.773
	Japan	0.792	Iceland	0.822
	Australia	0.814	Australia	0.829
	Iceland	0.821	Spain	0.852
	Spain	0.838	Portugal	0.876
	Portugal	0.874	Japan	0.896
	Israel	0.921	Israel	0.923
	Chile	0.957	Chile	0.960
	Venezuela	0.974	Venezuela	0.975
	Korea	0.976	Korea	0.985
	Malaysia	0.982	Malaysia	0.987
	Thailand	0.989	Thailand	0.991
Most Home Biased	Indonesia	0.997	Indonesia	0.998
Average by Group	Developed, excluding United States	0.698	Developed, excluding United States	0.715
	Emerging America	0.939	Emerging America	0.942
	Europe	0.741	Europe	0.814
	Asia	0.684	Asia	0.696
	Euro zone	0.910	Euro zone	0.929
		0.702		0.713

Note: Reproduced from Table 2 in Bekaert and Wang (2010).

### Alternative cost of capital models:

- The Arbitrage Pricing Theory
  - Ross, 1976
  - Accounts for the fact that other things besides the market cause systematic risk, e.g., inflation, interest rates, GDP, unemployment.
- The Fama-French Factor Model
  - Fama and French (1992)

- Book value of equity/market value of equity matters!
- The value and the small firm effects
- The Fama-French Three-Factor Model
  - CAPM-like factor
  - Small minus big
  - High BE/ME minus low BE/ME

## **Chapter 20- Foreign currency futures and options**

- **Futures (versus forwards)**
  - Allow individuals and firms to buy and sell specific amounts of foreign currency at an agreed-upon price determined on a given future day
  - ***Traded on an exchange*** (e.g., CME Group, NYSE Euronex's LIFFE CONNECT, and Tokyo Financial Exchange)
  - Standardized, smaller amounts (e.g., ¥12.5M, €125,000, C\$100,000)
  - **Fixed maturities (e.g., 30, 60, 90, 180, 360 days)**
  - Credit risk
    - Futures brokerage firms register with the Commodity futures trading commission (CFTC) as a futures commission merchant (FCM)
    - Clearing member/clearinghouse
- Margins
  - Credit risk is handled by setting up an account called a margin account, wherein they deposit an asset to act as collateral
    - The first asset is called the initial margin
    - Asset can be cash, U.S. govt obligations, securities listed on NYSE and American Stock Exchange, gold warehouse receipts or letters of credit
    - Depend on size of contract and variability of currency involved)
  - Marking to market – deposit of daily losses/profits
  - Maintenance margins – minimum amount that must be kept in the account to guard against severe

fluctuations in the futures prices (for CME, about \$1,500 for USD/GBP and \$4,500 for JPY/USD)

- **Margin call – when the value of the margin account reaches the maintenance margin**
  - the account must be brought back up to its initial value
- Euro contract (€125,000)
  - In September, You “go long in December Euro” (you buy a Euro contract deliverable in December) on September 16<sup>th</sup>, maintenance margin: \$1500

	Settle Price (Second column)	Contract size*delta(F) (4 <sup>th</sup> column)		Initial Margin – for Both buyer and seller (Last column)	
Day	Futures Price (\$/€)	Change in Futures Price (\$/€)	Gain or Loss	Cumulative Gain or Loss	Margin Account
$t$	1.3321	0	0		\$2,000.00
$t+1$	1.3315	-\$0.0006	-\$75.00	-\$75.00	\$1,925.00
$t+2$	1.3304	-\$0.0011	-\$137.50	-\$212.50	\$1,787.50
$t+3$	1.3288	-\$0.0016	-\$200.00	-\$412.50	\$1,587.50
$t+4$	1.3264	-\$0.0024	-\$300.00	-\$712.50	\$2,000.00
$t+5$	1.3296	+\$0.0032	+\$400.00	-\$312.50	\$2,400.00
$t+6$	1.3301	+\$0.0005	+\$62.50	-\$250.00	\$2,462.50

*Notes:* The futures price column lists the daily settle prices in the futures market. The contract size for the euro contract is assumed to be €125,000. The initial margin is \$2,000, and the maintenance margin is \$1,500. The gain or loss is the change in the futures price (\$/€) multiplied by the size of the contract. The cumulative gain or loss is the sum of the daily gain or loss.

**\*The Margin call is the \$2M @  $t+4$ , in the margin account.\***

- The pricing of futures contracts
  - The payoff on a forward contract:  $S(T)-F(t)$  where  $S(T)$  is the future spot rate at maturity time  $T$  and  $F(t)$  is the forward price at time  $t$

- The payoff on a futures contract:  $f(T) - f(t)$  where  $f(T)$  is the futures price at maturity time T and  $f(t)$  is the futures price at time t
- Why payoffs for futures can differ than those from forwards – the interest that is earned on future profits or that must be paid on future losses in a futures contract.

### Some Futures Quotes:

Contract Size	JPY12,500,000			CAD100,000			GBP62,500			EUR125,000		
Exchange Rate	USD per 100 JPY			USD per CAD			USD per GBP			USD per EUR		
Maturity	JUN	SEP	DEC	JUN	SEP	DEC	JUN	SEP	DEC	JUN	SEP	DEC
Open Price	1.2111	1.2136	1.2193	1.0486	1.0475	1.0478	1.6387	1.6460	—	1.4505	1.4454	1.4444
High Price	1.2256	1.2261	1.2257	1.0563	1.0534	1.0502	1.6590	1.6562	—	1.4631	1.4585	1.4510
Low Price	1.2111	1.2125	1.2138	1.0472	1.0447	1.0416	1.6376	1.6356	—	1.4487	1.4447	1.4444
Settle Price	1.2232	1.2241	1.2254	1.0491	1.0463	1.0431	1.6538	1.6514	—	1.4555	1.4512	1.4468
Change in Price	0.0093	0.0093	0.0093	0.0027	0.0026	0.0024	0.0141	0.0141	—	0.0058	0.0058	0.0060
Open Interest	125,635	1,312	119	139,545	2,781	2,481	112,115	430	—	246,358	3,137	86

Contract Size	CHF125,000			AUD100,000			MXN500,000			EUR100,000		
Exchange Rate	USD per CHF			USD per AUD			USD per 10 MXN			JPY per EUR		
Maturity	JUN	SEP	DEC	JUN	SEP	DEC	JUN	SEP	DEC	JUN	SEP	DEC
Open Price	1.1256	1.1275	—	1.0636	1.0535	—	0.8575	—	—	119.39	—	—
High Price	1.1392	1.1393	—	1.0710	1.0578	—	0.8605	—	—	119.39	—	—
Low Price	1.1249	1.1257	—	1.0613	1.0485	—	0.8545	—	—	118.83	—	—
Settle Price	1.1324	1.1329	—	1.0681	1.0550	—	0.8580	—	—	119.02	—	—
Change in Price	0.0071	0.0072	—	0.0077	0.0076	—	0.0008	—	—	-0.38	—	—
Open Interest	71,895	123	—	146,579	—	—	172,588	—	—	7,242	—	—

Note: All contracts except the JPY/EUR are traded on the CME Group. The JPY/EUR contract is trade on ICE Futures U.S. Data sources are Thomson Reuters and the Wall St. Journal Market Data Group.

\*Largest open interest in in the contract closest to maturity

\*Volume traded = contract size \* # contracts traded

### Example 20.2

It is mid-February and Nancy Foods expects a receivable of €250,000 in one month

- Will need 2 contracts (since they are €125,000)
- Wants to receive \$'s when the € weakens (protect against a loss in receivable) – SELL A € CONTRACT
- If contract delivery date coincides with receivable date, maturity is matched perfectly
- Example: February: Spot (\$1.24/€); Future (\$1.23/€); March: Spot (\$1.35/€); Future (\$1.35/€); 30-day  $i_{€}=3\%$  p.a.; receivable in 30 days

Value upon receipt of money (mid-March)

- Sell receivable in spot market in March =  $\$250,000 * \$1.35/€ = \$337,500$
- Loss on futures contract:  $[(\$1.23/€) - (\$1.35/€)] * €250,000 = -\$30,000$

- Combination of CFs:  $\$337,500 - \$30,000 = \$307,500$
- Effective exchange rate:  
 $\$307,500 / \text{€}250,000 = \$1.23/\text{€}$ , but

this is the futures rate so it shows that they are hedged

## ICI

### Hedging transaction risk with futures.

- Potential problems with a futures hedge
  - What if you need to hedge an odd amount?
  - What if the contract delivery date doesn't match your receivable/payable date?
  - Basis risk – if the price of the futures contract does not move one-for-one with the spot exchange rate
    - Basis = Spot price – Futures price =  $S(t) - f(t,T)$

Time	Value of Receivable	Cumulative Value of Futures Hedge (short position)	Value of Hedged Position
$t$	$S(t)$	0	$S(t)$
$t+1$	$S(t+1)$	$f(t) - f(t+1)$	$f(t) + [S(t+1) - f(t+1)]$
$t+2$	$S(t+2)$	$[(f(t+1) - f(t+2)) + [f(t) - f(t+1)]]$ $= f(t) - f(t+2)$	$f(t) + [S(t+2) - f(t+2)]$
$\vdots$		$\vdots$	$\vdots$
$T$	$S(T)$	$f(t) - f(T)$	$f(t) + [S(T) - f(T)]$

Note: The hedged position reflects the sum of the previous two columns.

### Hedging transaction risk with futures

#### **Example: Euro receivable and basis risk- 20.2.1:**

Nancy Foods has a receivable €250,000 in early March. Contract delivery date is the 3<sup>rd</sup> week of March

	Spot Rate	Futures Rate (March contract)
January	\$1.21/€	\$1.22/€
March	\$1.33/€	\$1.325/€

Value at time of receipt of money (mid-March):

Euro receivables in the spot market:  $\$50,000 * \$1.33/\text{€} = \$332,500$

Change in value of the futures contract:

$[(\$1.22/\text{€}) - (\$1.325/\text{€})] * \text{€}250,000 = -\$26,250$

Total cash flow:  $\$332,500 - \$26,250 = \$306,250$

Effective Exchange Rate:  $\$306,250 / \text{€}250,000 = \$1.225/\text{€}$

***This doesn't equal the futures rate because of basis risk***

- Gives the buyer the right, but not the obligation to buy (call) or sell (put) a specific amount of foreign currency for domestic currency at a specific forex rate
  - Price is called the premium
  - Traded by money center banks and exchanges (e.g., NASDAQ OMX PHLX)
  - European vs. American options: European options can only be exercised on maturity date; Americans can be exercised anytime (i.e., "early exercise" is permitted)
  - Strike/exercise price ("K") – forex rate in the contract
  - Intrinsic value – revenue from exercising an option
    - In the money/out of the money/at-the-money
      - Call option:  $\max[S-K, 0]$
      - Put option:  $\max[K-S, 0]$
      -

**Basics of foreign currency option contracts**

A particular euro call option offers the buyer the right (but not the obligation) to purchase €1M @ \$1.20/€.

If the price of the € > K, owner will exercise (think coupon)

To exercise: the buyer pays  $(\$1.20/\text{€}) * \text{€}1\text{M} = \$1.2\text{M}$  to the seller and the seller delivers the €1M

The buyer can then turn around and sell the € on the spot market at a higher price!

For example, if the spot is, let's say, \$1.25/€, the revenue is:

$[(\$1.25/\text{€}) - (\$1.20/\text{€})] * \text{€}1\text{M} = \$50,000$  (intrinsic value of option, NOT the profit)

Thus buyer could simply accept \$50,000 from seller if the parties prefer

A particular yen put option offers the buyer the right (but not the obligation) to sell ¥100M @ £0.6494/¥100.

If the price of the ¥100 < K, owner will exercise (think insurance)

To exercise: the buyer delivers ¥100M to the seller

The seller must pay  $(\text{£}0.6494/\text{¥}100) * \text{¥}100\text{M} = \text{£}649,400$

For example, let's say the spot at exercise is £0.6000/¥100.

The revenue then is:

$[(\text{£}0.6494/\text{¥}100) - (\text{£}0.6000/\text{¥}100)] * \text{¥}100\text{M} = \text{£}49,400$  (intrinsic value of option, NOT the profit)

Thus buyer could simply accept £49,400 from seller if the parties prefer

## Basics of currency options:

- Options trading
  - Mostly traded by banks in the interbank market or the OTC market
    - Typically European convention in OTC market
    - CFs either exchanged or cash settlement
    - Considerable counterparty risk – managed by exposure limits
  - Currency options on the NASDAQ OMX PHLX
    - Mostly options on spot currencies vs U.S. Dollar
    - Expiration months: March, June, September and December
    - Last trading day is the third Friday of expiring month
    - European-exercise type but settlement is in dollars
    - Options Clearing Corporation serves as clearinghouse

## Prices of options and future contracts:

Currency	Type	Maturity	Strike Prices					
			900	950	1000	1050	1100	1150
Canadian Dollar	Calls	May	14.91	9.91	4.93	0.68	0.01	—
		Jun	14.91	9.93	5.04	1.20	0.08	—
		Sep	14.7	9.91	5.55	2.26	0.63	0.18
CAD100,000 USD cents per CAD	Puts	May	—	—	0.02	0.77	5.10	10.09
		Jun	—	0.02	0.14	1.29	5.17	10.09
		Sep	0.11	0.31	0.94	2.63	5.98	10.52
Swiss Franc	Calls	May	13.24	8.24	3.34	0.37	0.02	—
		Jun	13.24	8.27	3.73	0.96	0.17	0.05
		Sep	13.42	8.86	5.04	2.47	1.12	0.59
CHF 125,000 USD Cents per CHF	Puts	May	-	-	0.10	2.13	6.78	10.76
		Jun	-	0.04	0.49	2.72	6.92	10.80
		Sep	0.17	0.60	1.76	4.17	7.81	11.27
Euro	Calls	May	3.85	3.01	2.26	1.6	1.08	0.69
		Jun	4.49	3.75	3.09	2.48	1.95	1.49
		Sep	6.04	5.41	4.83	4.29	3.78	3.31
EUR125,000 USD Cents per EUR	Puts	May	0.30	0.46	0.68	1.05	1.53	2.14
		Jun	0.94	1.17	1.59	1.93	2.40	2.94
		Sep	2.93	3.30	3.71	4.14	4.66	5.18
British Pound	Calls	May	24.38	19.38	14.38	9.40	4.51	0.83
		Jun	24.38	19.38	14.41	9.50	4.96	1.59
		Sep	24.24	19.42	14.74	10.33	6.46	3.46
GBP62,500 USD Cents per GBP	Puts	May	0.02	0.02	0.01	0.02	0.13	1.45
		Jun	0.01	0.01	0.04	0.13	0.53	2.21
		Sep	0.16	0.33	0.64	1.22	2.33	4.32
Japanese Yen	Calls	May	10.32	5.38	1.26	0.16	0.03	0.01
		Jun	10.38	5.65	2.07	0.59	0.18	0.06
		Sep	10.97	6.93	3.95	2.11	1.13	0.62
JPY12,500,000 USD Cents per 100 JPY	Puts	May	0.01	0.06	0.94	4.84	9.71	14.69
		Jun	0.07	0.34	1.75	5.26	9.85	14.73
		Sep	0.59	1.54	3.54	6.68	10.69	15.17

Note: All contracts are traded at the CME Group. Data are from Thomson Reuters and the Wall Street Journal Market Data Group.

- Exchange-listed currency warrants
  - Longer-maturity foreign currency options (>1 year)
  - Issued by major corporations
  - Actively traded on exchanges such as the American Stock Exchange, London Stock Exchange, and Australian Stock Exchange
  - American-style option contracts
  - Issuers include AT&T, Ford, Goldman Sachs, General Electric, etc.

- Not taking on currency risk – likely hedged in OTC market
  - Buying an option at wholesale price and selling at retail price
- Allow retail investors and small corporations too small to participate in OTC market to purchase L/T currency options

### Example 20.3.1: Macquarie Put Warrant

AUD put warrant against \$ - maturity date of December 15, 2010

K = \$0.90/AUD; multiplier of AUD10

Payoff of put warrant specified in contract as:

$\text{Max} [0, (K-S)/S] * \text{Multiplier}$

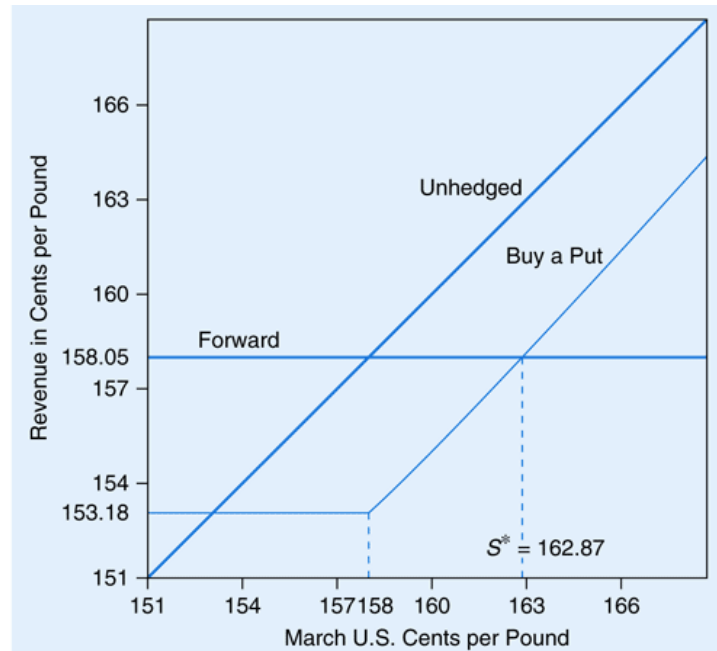
Suppose spot at maturity is \$0.85/AUD, the payoff then is:

$[(\$0.90/\text{AUD}) - (\$0.85/\text{AUD})] / \$0.85/\text{AUD} * 10 = \$0.59$

*Since the actual spot exchange rate at maturity was \$1.0233/AUD, the holder of the warrant at maturity received no payoff*

*Next Example:*

It is Friday, 10/1/10: Pfimerc has a receivable of £500,000 on Friday, 3/19/11.			
Spot (U.S. cents per £): 158.34	<b>Strike</b>	<b>Call Prices</b>	<b>Put Prices</b>
170-day forward rate (U.S. cents per £): 158.05	158	5	4.81
U.S. dollar 170-day interest rate: 0.20% p.a.	159	4.52	5.33
British pound 34-day interest rate: 0.40% p.a.	160	4.08	5.89
Option data for March contracts in ¢/£:			
How should Pfimerc hedge?			
£ Put Option: gives them the right (but not the obligation) to sell pounds at a specific price if the £'s value falls			
Because Pfimerc wants to sell £500,000, it must pay:			
$£500,000 * (\$0.0481/£) = \$24,050$			
They will exercise if the £ falls below \$1.58/£			
$500,000 * \$1.58/£ = \$790,000$ if $S(t+170) \leq \$1.58/£$			
They will sell £'s in the spot market if the £ is worth more than \$1.58			
$500,000 * S(t+170) > \$790,000$ if $S(t+170) > \$1.58/£$			
Either way, the cost of the put = $[\$24,050 * (1 + (0.002 * 170 / 360))] = \$24,073$			
The minimum revenue is therefore: $\$790,000 - \$24,073 = \$765,927$			



*Notes:* The horizontal axis presents different possible future exchange rates. The vertical axis represents the revenue in cents per pound from three different strategies. The horizontal line reflects the revenue implied by a forward contract, which is not dependent on the future exchange rate. The upward-sloping 45-degree line represents the unhedged strategy. The revenue equals the future exchange rate. The “hockey stick” line represents the revenue from hedging the receivable by buying a pound put option.

### **The use of options in risk management**

- Hedging with options as buying insurance
  - Hedging foreign currency risk with forwards and options
  - Options as insurance contracts
    - As amount of coverage increases so does the cost (premium) to insure
  - Changing the quality of the insurance policy – make ceiling on our cost of the foreign currency as low as possible.

## Hedging and speculating strategies:

	Underlying Transaction	
	Foreign Currency Receivable	Foreign Currency Payable
Forward Hedge (or futures hedge)	Sell forward (Go short)	Buy forward (Go long)
Option Hedge	Buy a put Establishes a revenue floor of $K - (1 + i)P$	Buy a call Establishes a cost ceiling of $K + (1 + i)C$
Option Speculation	Sell a call Imposes a revenue ceiling of $K + (1 + i)C$ but allows unlimited risk	Sell a put Imposes a liability floor of $K - (1 + i)P$ but allows unlimited risk

*Notes:*  $K$  is the strike price,  $C$  is the call option premium,  $P$  is the put option premium, and  $i$  is the appropriate deannualized interest rate factor.

To hedge CHF 750,000 Payable

X    Call    Put

70 2.55    1.42

72 1.55    2.40

Size: CHF 62,500

Exercise if price >70¢ or 72¢, respectively

WANT PAYABLE TO BE AS CHEAP AS POSSIBLE! Need 12 contracts

1<sup>st</sup> Option (K=70¢) Cost:

$12 * CHF62,500 * \$0.0255 = \$19,125$

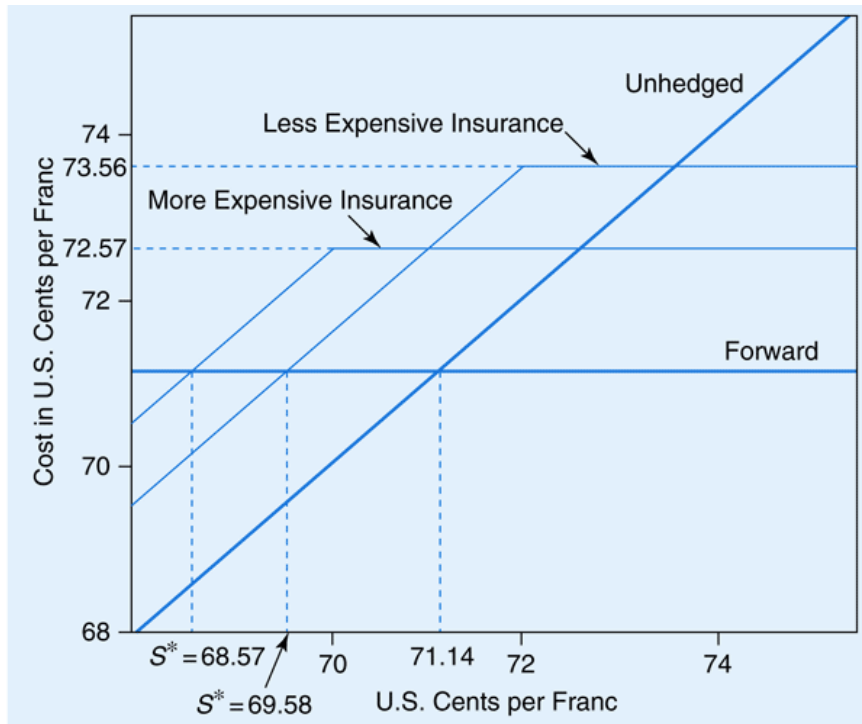
2<sup>nd</sup> Option (K=72¢) Cost:

$12 * CHF62,500 * \$0.0155 = \$11,625$

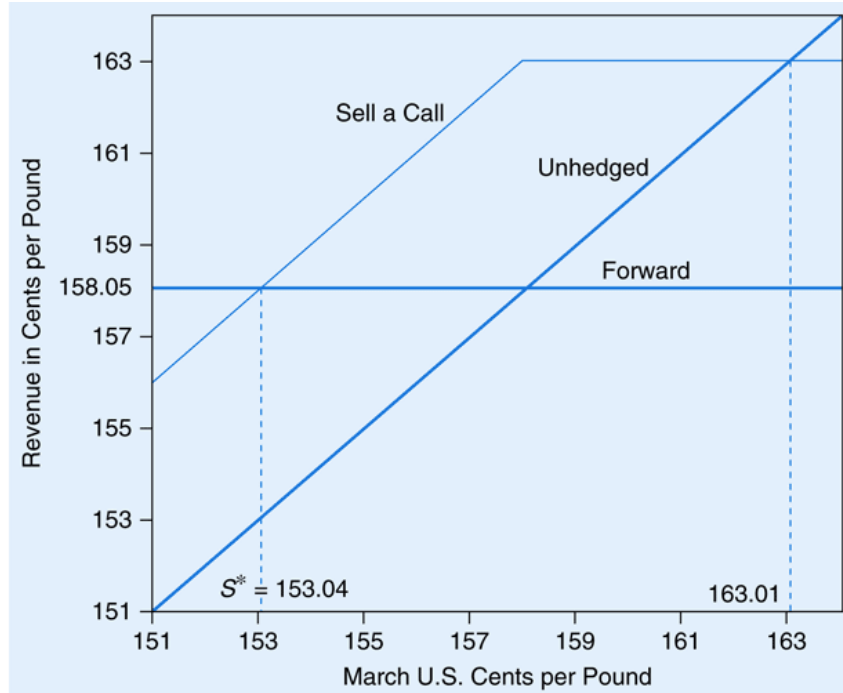
Option with lower K costs more. On an

all-in cost basis, the dollar must strengthen more against the CHF before the cost is lower than the cost of the forward hedge

### Alternative options hedging



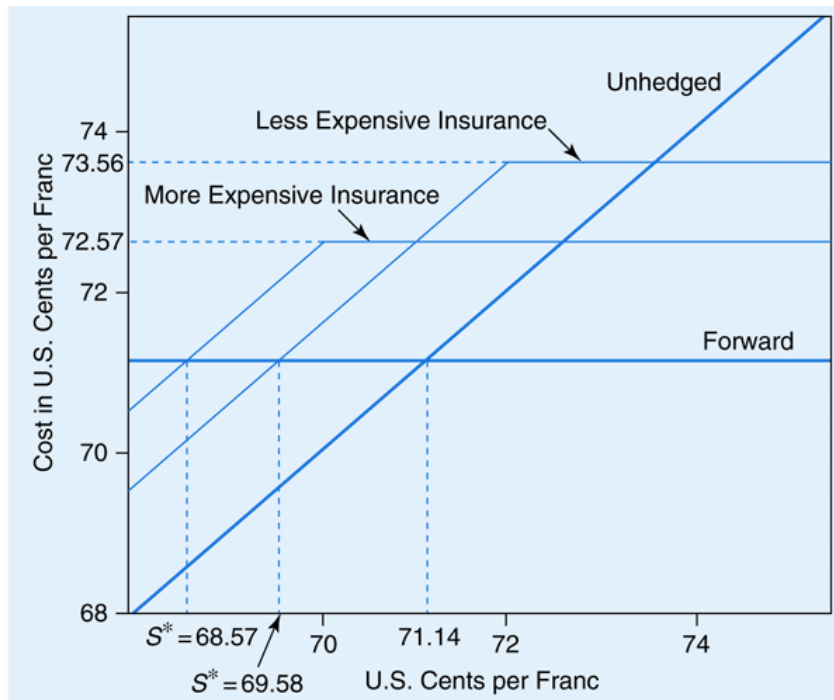
*Notes:* The horizontal axis represents the future exchange rate in cents per Swiss franc. The vertical axis represents the cost in cents per Swiss franc of various strategies for dealing with a Swiss franc liability. The horizontal line shows that a forward hedge locks in a cost per Swiss franc of 71.14 cents. The 45-degree line represents the unhedged strategy, and the two inverted “hockey stick” lines represent the *ex post* costs of two option strategies, struck at different strike prices.



Notes: The horizontal axis represents the future exchange rate in cents per pound. The vertical axis represents the revenue in cents per pound of various strategies for selling a pound asset. The horizontal line shows that a forward hedge locks in revenue of 158.05 cents. The 45-degree line represents the unhedged strategy, and the inverted “hockey stick” line represents the *ex post* revenue from the strategy of selling a call option with a strike price of 158.

- Speculating with options – you can “sell” insurance if buying it seems too expensive
  - Speculating on £ receivables
    - Sell a £ call option
      - Generates \$ revenue, which enhances \$ return
      - Dangerous though in that one loses protection against downside risk
  - Speculating on foreign currency liabilities
    - Sell a foreign currency put option
      - If future forex rate > K, you are forced to buy at market and that is more expensive
      - If future forex rate < K, you are forced to buy at K BUT you earned revenue so as long as it doesn’t increase too much, it’s okay
- Options valuation – Black and Scholes (1973)
  - The intrinsic value of an option – if the owner exercises it, will it make money (in/at/out of the money)?

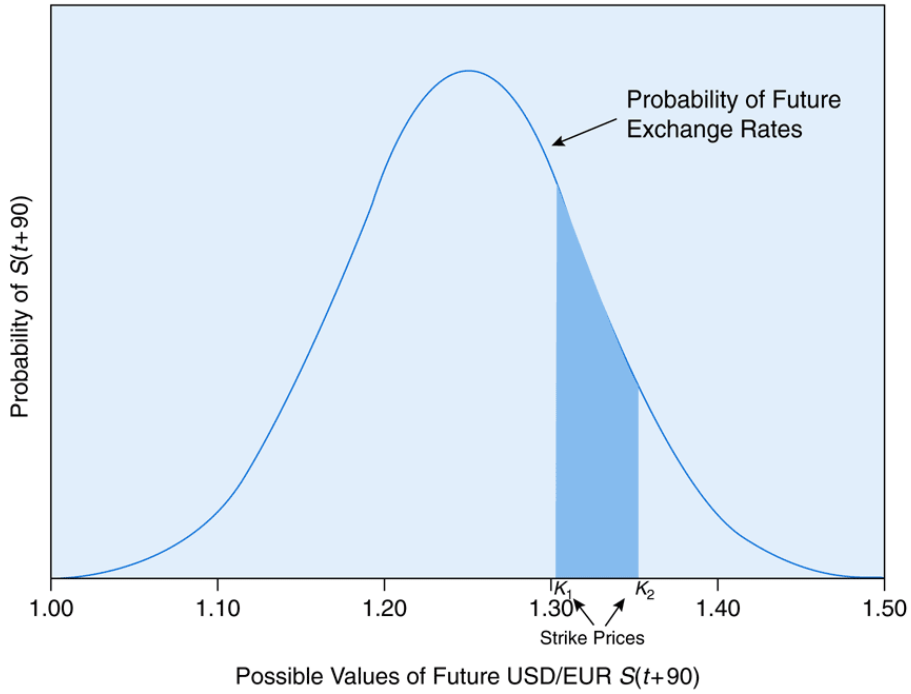
- The time value of an option – the part of the option’s value attributed to the time left to expiry
  - Time value = Option price – intrinsic value
- Increasing the exercise price (call) –it reduced the probability that the option will be exercised so it decreases the option’s value



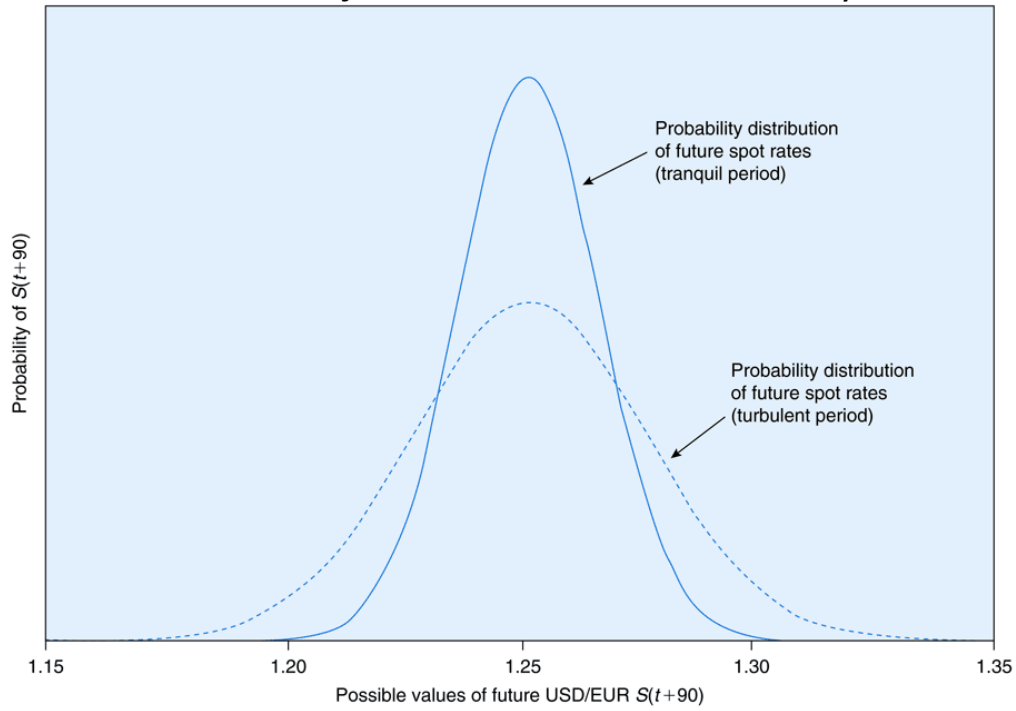
*Notes:* The horizontal axis represents the future exchange rate in cents per Swiss franc. The vertical axis represents the cost in cents per Swiss franc of various strategies for dealing with a Swiss franc liability. The horizontal line shows that a forward hedge locks in a cost per Swiss franc of 71.14 cents. The 45-degree line represents the unhedged strategy, and the two inverted “hockey stick” lines represent the *ex post* costs of two option strategies, struck at different strike prices.

- An increase in the variance – the distribution with the larger variance yields possibly larger payoffs so it increase the option’s value
- Increasing the time to expiration
  - American – increases uncertainty of spot rate at maturity so it increases the option’s value
  - European – generally increases the option’s value but it depends because in-the-money European options can lose value as time evolves

### Exhibit 20.11 Different Probability Distributions of Future USD/EUR



### Different Probability Distributions of Future USD/EUR



- 
-

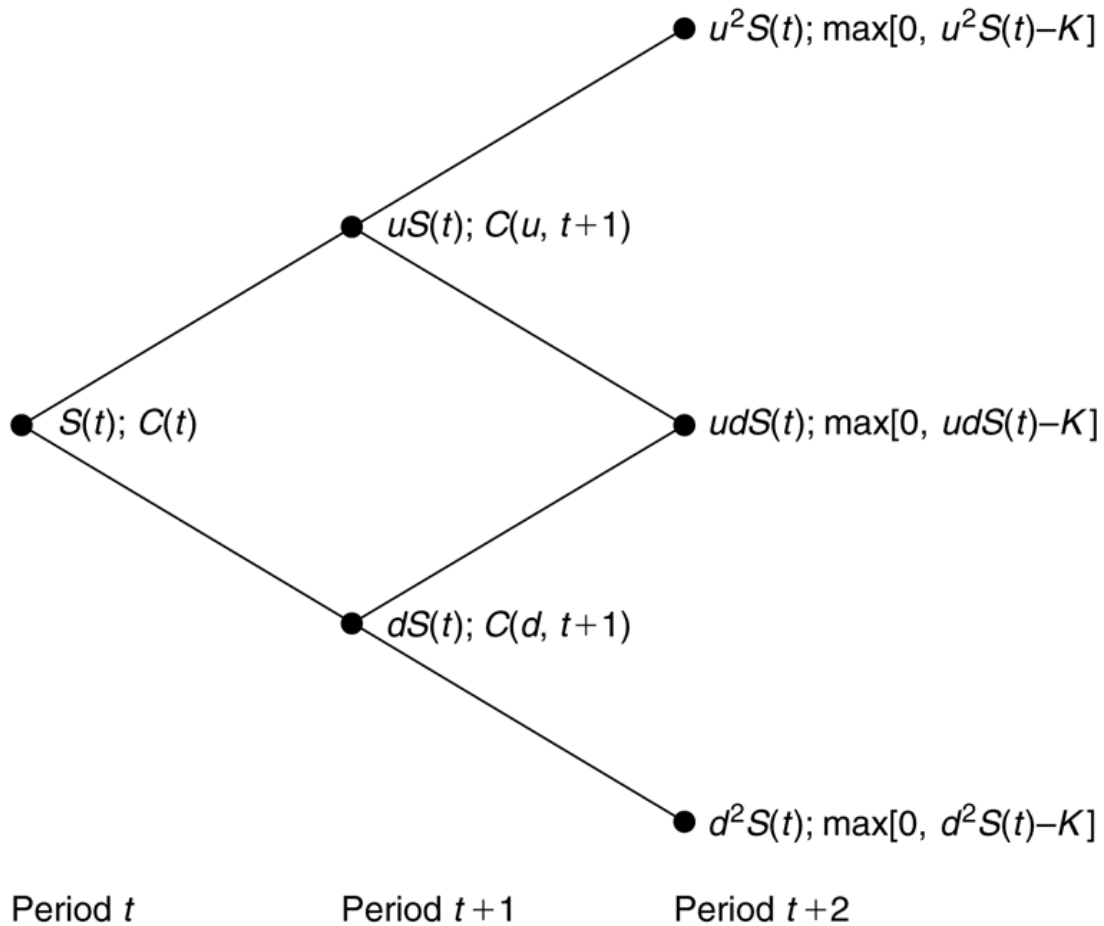
- **Put-call parity for foreign currency options** – links the K of domestic currency (per foreign unit of currency), the domestic currency prices of European-style put and call options at that K, and the domestic currency interest rate.
  - **Synthetic forward contract – using put and call options (same K) simultaneously**; e.g., to unconditionally sell € forward, you can purchase a € put option for P and write a € call option for revenue C. Both are at strike price K.
    - Put-Call Parity Condition:  $F = K + (C - P)[1 + i(\$)]$
    - “Conversion” happens if you can purchase €’s cheaper on the forward market and arbitrage
      - Reversal is when the market’s forward price is higher than the synthetic forward
- Exotic options - options with different payoff patterns than the basic options
  - Range forward contract – allows a company to specify a range of future spot rates over which the firm can sell or buy forex at the future spot rate
    - No money up front
  - Cylinder options – allow buyers to specify a desired trading range and either pay money or potentially receive money up front for entering into the contracts
  - Both can be synthesized
    - buying a call and selling a put (at a lower K)
    - For range forward – K must be set such that  $P(K_p) = C(K_c)$
    -

### **Combination of options and exotic options**

- **Average-rate options (or “Asian” option)** - most common exotic option; payoff is  $\max[0, \hat{S} - K]$  where  $\hat{S}$  defines the average forex rate between the initiation of the contract and the expiration date (source and time interval are agreed upon)
- Barrier options – regular option with additional requirement that either activates or extinguishes the option if a barrier forex rate is reached

- Lookback options – option that allows you to buy/sell at least/most expensive prices over a year (more expensive than regular options)
- Digital options (“binary” options) – pays off principal if  $K$  is reached and 0 otherwise (think lottery)

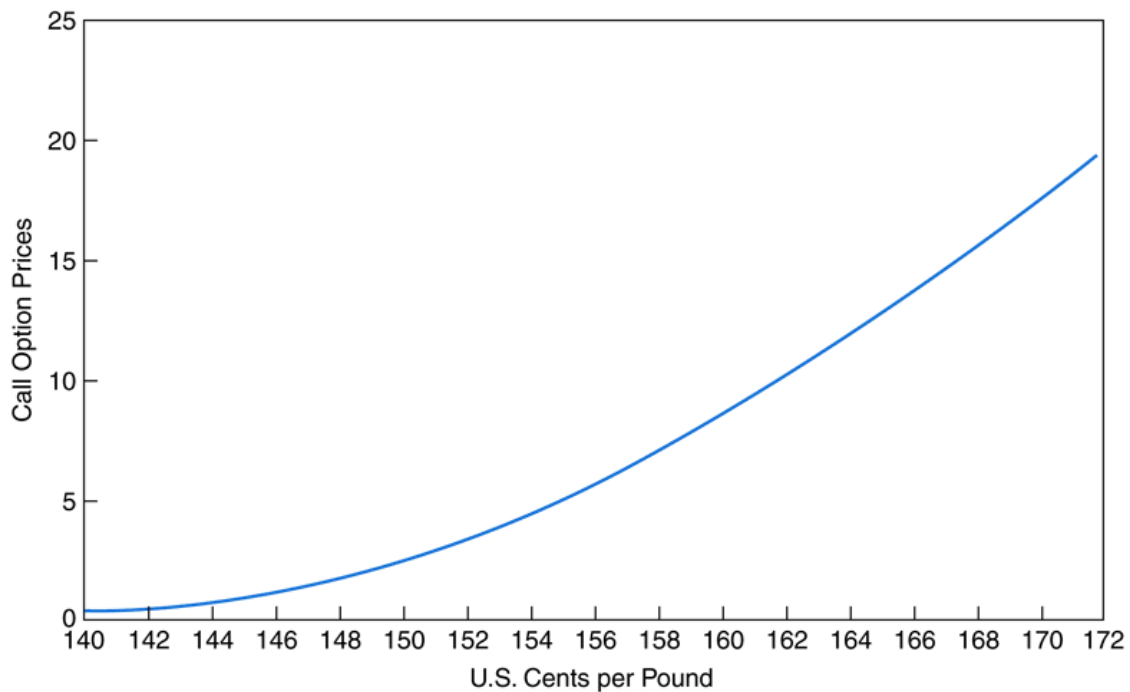
### Two-period binomial tree



Vol.	Strike	$i^{\$} = 1\%$			$i^{\$} = 4\%$			$i^{\$} = 7\%$		
		Fraction of a Year to Maturity								
$\sigma$	K	0.25	0.50	0.75	0.25	0.50	0.75	0.25	0.50	0.75
8%	145	4.49	4.39	4.27	5.30	5.75	6.10	6.16	7.29	8.27
8%	150	1.70	2.06	2.23	2.18	2.95	3.48	2.74	4.06	5.12
8%	155	0.44	0.80	1.02	0.54	1.27	1.77	0.86	1.91	2.86
12%	145	5.53	5.99	6.26	6.24	7.24	7.98	7.00	8.61	9.92
12%	150	2.87	3.66	4.13	3.36	4.60	5.48	3.91	5.68	7.07
12%	155	1.27	2.07	2.59	1.55	2.72	3.59	1.88	3.49	4.82
16%	145	6.62	7.61	8.24	7.29	8.79	9.89	7.99	10.07	11.70
16%	150	4.04	5.29	6.09	4.54	6.25	7.47	5.09	7.31	9.03
16%	155	2.26	3.53	4.38	2.61	4.27	5.51	2.99	5.11	6.81

Note: The maturities of the options are 91 days, 182 days, or 273 days with a 365-day year.

Call option price:

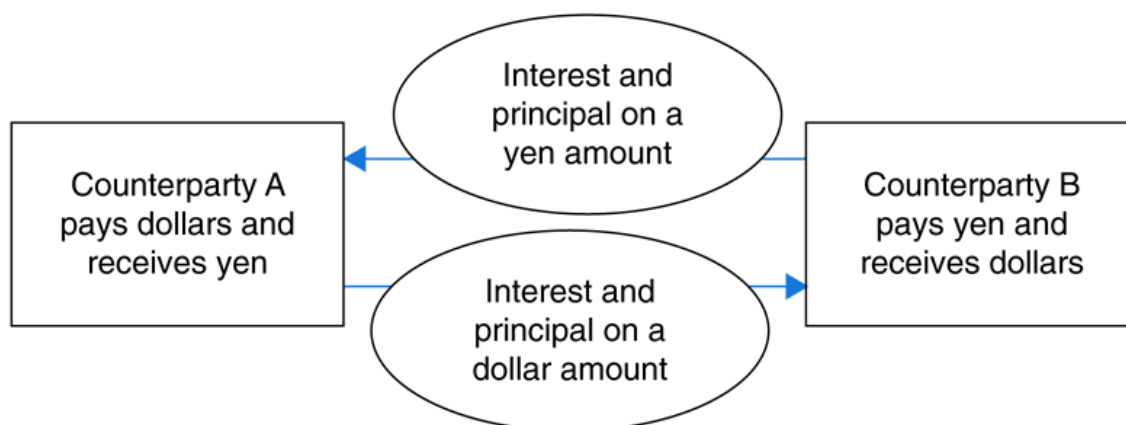


## **Chapter 21- Interest rates and foreign currency swaps**

- Swaps – agreements between two counterparties to exchange a sequence of cash flows
  - Structured like the cash flows of bonds
  - Maturities extend from 1 – 30 years or more
  - Used to manage interest rate and currency risks
  - Can be used to speculate!

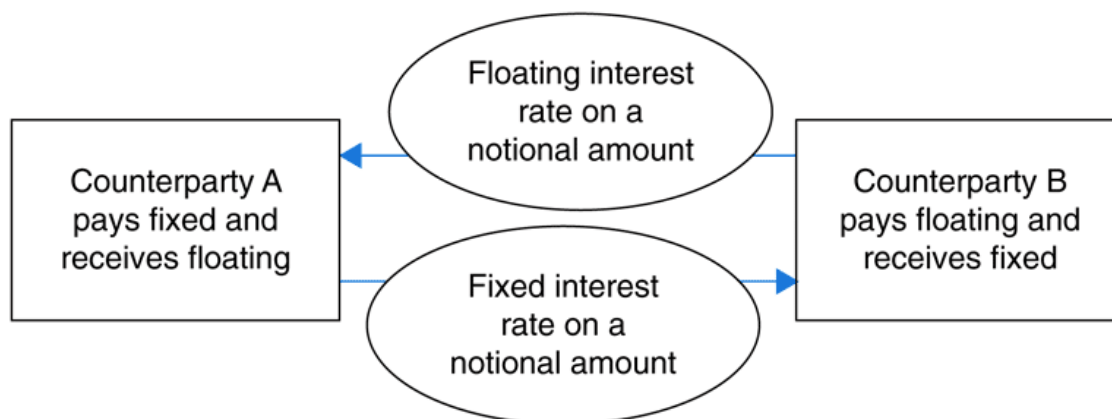
- Contract based on best practices as suggested by the International Swaps and Derivatives Association (ISDA)
  - >800 member institutions from 56 countries
  - Most important document is the ISDA Master Agreement Protocol – controls legal aspects of swap cash flows
  
- Parallel loans
  - A means of securing low-cost funding for foreign subsidiaries
  - A parent of one company lends currency to a separate company's subsidiary operating in their domicile nation and the same for the other parent/subsidiary
    - 2 separate contractual obligations
  - To circumvent various government regulations such as currency controls
  - Avoids taxation on intra-company multinational transactions
  
- Back-to-back loans
  - Simultaneous loans between multinational parent corporations in two different countries
  - Contain the right to offset – a clause that stipulates that if one party defaults on a payment, the other party can withhold corresponding payments of equal value
    - Some countries have restrictions on offsets, which makes back-to-back loans less common

Basic aspects of currency swaps and interest rate swaps - allows an MNC to change the currency of denomination or the nature of the interest rate on its debt



**Interest rate swap diagram:**

Basic aspects of currency swaps and interest rate swaps - allows an MNC to change the currency of denomination or the nature of the interest rate on its debt



	Currency Swaps		Interest Rate Swaps		Credit Default Swaps	
	Notional Amounts	Gross Market Value	Notional Amounts	Gross Market Value	Notional Amounts	Gross Market Value
June 2001	3,823	314	51,407	1,404	—	—
June 2004	7,033	442	127,570	3,562	—	—
June 2007	12,291	617	271,853	5,315	42,580	721
June 2010	16,347	1,187	347,508	15,951	30,261	1,666

*Note:* Data are taken from various December issues of the Bank for International Settlements *Quarterly Review*.

- Size of the swap market
  - Growth since their introduction in 1980 has been amazing

- 2001: \$51 trillion (IR swaps) and \$4 trillion (FX swaps)
- 2010 \$347 trillion (IR swaps) and ~\$8 trillion (FX swaps)
- Gross market value
  - 4.59% of notional value for IR swaps and 7.26% for FX swaps
  - Value for one side is loss for the other – Long Term Capital Management (LTCM) lost \$1.6 billion on trades in the swap market
  - Now marking-to-market, borrowed from the futures market is used to manage counterparty risk
- Credit default swaps and the financial crisis
  - Credit default swap (CDS) was devised by JP Morgan bankers – bilateral insurance contract between a protection buyer and a protection seller to protect against default on a specific bond or loan issued by a corporation or sovereign
  - In 2000s, the prevalence of these contracts grew exponentially due to speculative investing by institutional investors and hedge funds
  - Many of these contracts were written on subprime mortgages and when the defaults began to increase, the sellers were in trouble (one of the biggest being AIG)
  - Many countries are considering regulating these now

### Interest rate swaps

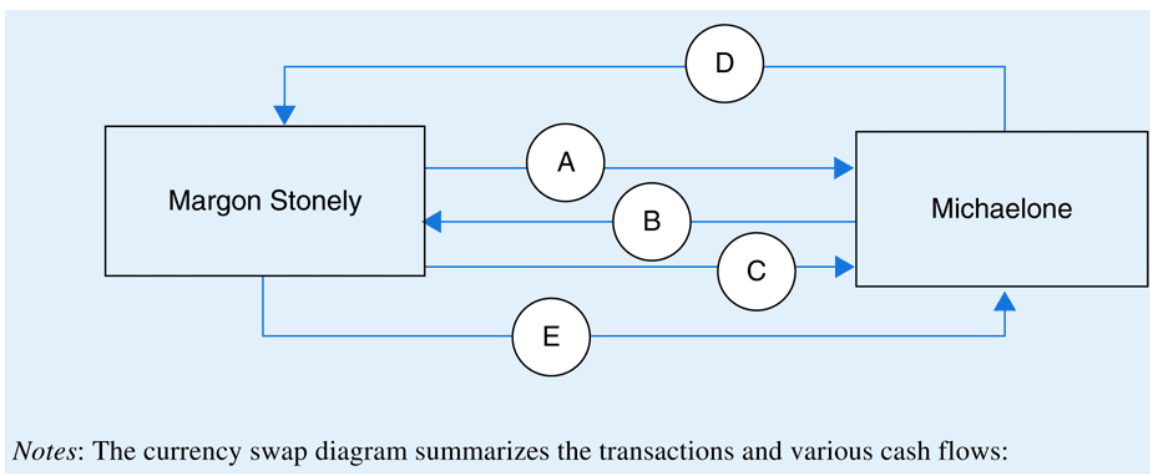
- Allow corporations to manage their interest rate risk or to speculate on the direction of interest rates
- Example: Jocko Sports is paying the floating rate side of a \$ IR swap and receiving fixed interest rate payments from Banco Coloro.
  - Notional principal: \$25M; term: 5 yrs; fixed interest rate: 8%
  - semi-annual payments
    - Banco Coloro pays  $0.5 * 0.08 * \$25M = \$1M$
    - Jocko Sports pays semi-annual pmnts on \$25M at LIBOR
    - Net payment is transferred (currency is the same)

- Why use interest rate swaps?
  - A company whose CFs are pro-cyclical can borrow at short-term IRs, which are also pro-cyclical
  - If that same company borrowed at long-term fixed rates, the risk of default in economic contractions increases
  - Short-term rates are not without risk though – lenders can just cut off funds to borrowers
  - Changed circumstances may change the preference for the nature of debt – IR swaps allows for this change

Views on the future influence this choice of debt as well as whether a company will enter into an IR swap.

- Minimizing the cost of debt - shaving off even a few basis points can save a company millions of dollars
- Manipulating earnings –swaps can be used by managers to ensure that they make earnings expectations
- The nature of IR swap contracts
  - Commercial/investment banks serve as market makers
  - Quotes in the \$ IR swap market usually use 6-month LIBOR as the base rate of the floating rate side
  - The bank's bid IR is the fixed rate that the bank is willing to pay over a given maturity in return for receiving semiannual payments corresponding to 6-month LIBOR
  - The bank's ask IR is the fixed rate it will receive from a counterparty over a given maturity if the bank is to pay 6-month LIBOR
  - Swap spread – a number of basis points that are added to the yield to maturity on a U.S. government bond corresponding to that maturity
  - Notional principal – the amount of outstanding debt
  - Profits and risks for swap dealers – as long as the bank matches the amount of IR swaps for a given maturity in which it will give and receive fixed interest rate payments, it will earn the bid-ask spread on that aggregate amount (if not, it has interest rate risk)
  - Dealing with credit risk
    - Quoted rates indicate prices for customers that have the best credit!

- Banks either increase the bid-ask spread or ask for a collateral
- An agreement between two parties to exchange the CFs of two long-term bonds denominated in different currencies
  - Parties exchange initial principal amounts (at spot)
  - Parties pay interest on the currency they initially receive, receive interest on the currency they initially pay and reverse the exchange of initial principal amounts at a fixed future date



Notes: The currency swap diagram summarizes the transactions and various cash flows:

- The mechanics of modern currency swaps
  - Typical quote
    - 5-year fixed IR (first) /FX (second) swaps
      - USD: 5.25% bid and 5.35% offered against 6-month dollar LIBOR
      - GBP: 8.00% bid and 8.10% offered against 6-month dollar LIBOR

CF

Time Period	Part 1		Part 2	
	Floyds Pays the \$ Fixed Rate	Floyds Receives the \$ Floating Rate	Floyds Pays the \$ Floating Rate	Floyds Receives the £ Fixed Rate
Year 0			\$360,000.000	(£200,000.000)
Year 0.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 1.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 1.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 2.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 2.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 3.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 3.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 4.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 4.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 5.0	(\$9,630.000)	LIBOR × \$360 m	(\$360,000.000 + LIBOR × \$360 m)	£200,000.000 + £8,000.000

Notes: The interest rate at which Commercial Credit receives fixed dollar payments is 5.35% p.a., and  $(0.5) \times (0.0535) \times \$360 \text{ million} = \$9.63 \text{ million}$ . The interest rate at which Commercial Credit makes fixed pound payments is 8.00% p.a., and  $(0.5) \times (0.08) \times £200 \text{ million} = £8 \text{ million}$ .

Possible bond issues:

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	Dollar Bond Issues		Euro Bond Issues	
	Goodweek's Cash Flows	Bridgerock's Cash Flows	Goodweek's Cash Flows	Bridgerock's Cash Flows
Goodweek	200 Million @ 8.5% with 1.875% Fee		100 Million @ 13.5% with 2.25% Fee	
Bridgerock	200 Million @ 9.5% with 1.875% Fee		100 Million @ 13.75% with 2.25% Fee	
Year				
0	196.25	196.25	97.75	97.75
1	-17.00	-19.00	-13.50	-13.75
2	-17.00	-19.00	-13.50	-13.75
3	-17.00	-19.00	-13.50	-13.75
4	-17.00	-19.00	-13.50	-13.75
5	-217.00	-219.00	-113.50	-113.75
All-In Cost	8.98%	9.99%	14.16%	14.41%

Note: Yearly cash flows are in millions of dollars or euros.

- Comparative borrowing advantages in matched currency swaps
  - Goodweek and Bridgerock both want to issue 5-year fixed-rate debt
    - Goodweek wants to raise \$200M; Bridgerock wants to raise €100M (Spot = \$2/€, which equates the two notional amounts)
  - Dollar-denominated debt

- \$ Interest rates: Goodweek = 8.5%; Bridgerock = 9.5%
- Both companies pay 1.875% to bank
- Proceeds:  $(1-0.01875) * \$200M = \$196,250,000$

Annual coupon payment for Goodweek:  $0.085 * \$200M = \$17M$

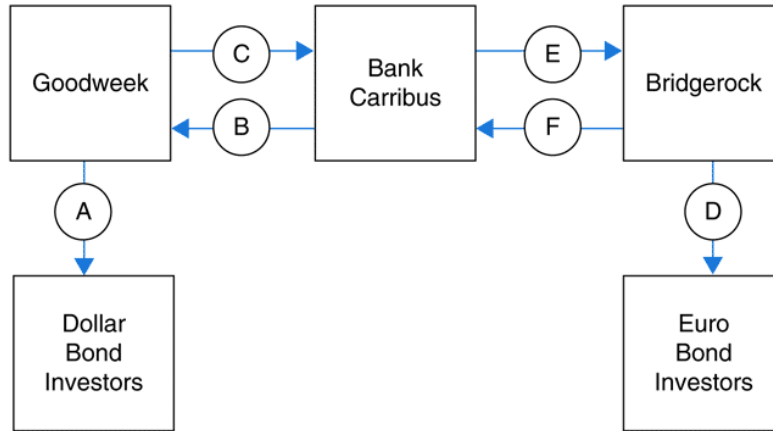
- Annual coupon payment for Bridgerock:  $0.095 * \$200M = \$19M$
- AIC for Goodweek = 8.98%; Bridgerock = 9.99%
- Euro-denominated debt
  - € interest rates: Goodweek = 13.5%; Bridgerock = 13.75%
  - Fees to banks = 2.25%
  - Proceeds:  $(1-0.0225) * €100M = €97.75M$
  - Annual coupon payment for Goodweek:  $0.135 * €100M = €13.5M$
  - Annual coupon payment for Bridgerock:  $0.1375 * €100M = €13.75M$
  - AIC for Goodweek = 14.16%; Bridgerock = 14.41%

- Denomination of bonds depends on hedging considerations
- Absolute vs. comparative advantage
  - Goodweek has absolute borrowing advantage in both currencies because its all-in costs are lower
  - Bridgerock has a comparative borrowing advantage issuing euro debt

Currency Swap with intermediary:

Year	Goodweek's Cash Flows			Bridgerock's Cash Flows			Bank Carribus's Cash Flows	
	\$ Bond Issue	Swap with Bank Carribus		€ Bond Issue	Swap with Bank Carribus		Net	
		Dollar	Euro		Dollar	Euro	Dollar	Euro
0	196.25	-196.25	99.83	97.75	191.57	-97.75	4.86	-2.08
1	-17.00	17.00	-13.75	-13.75	-17.00	13.75	0.00	0.00
2	-17.00	17.00	-13.75	-13.75	-17.00	13.75	0.00	0.00
3	-17.00	17.00	-13.75	-13.75	-17.00	13.75	0.00	0.00
4	-17.00	17.00	-13.75	-13.75	-17.00	13.75	0.00	0.00
5	-217.00	217.00	-113.75	-113.75	-217.00	113.75	0.00	0.00
AIC	8.98%	8.98%	13.80%	14.41%	9.60%	14.41%	Bank Carribus's net dollar profit 0.5206	

Note: All cash flows are in millions of dollars or euros.



*Notes:* The currency swap diagram summarizes the rates of return and the various cash flows:

- A. Goodweek issues \$200 million of bonds to investors with 8.5% coupons. After fees of 1.875%, the AIC is 8.98%.
- B. Goodweek gives the net proceeds of the bond issue, \$196.25 million, to Bank Carribus in exchange for €99.83 million, which is the present value at 13.80% of the € cash flows given in C. Goodweek receives from Bank Carribus the dollar interest and principal payments that it owes to bondholders in A.
- C. Goodweek makes the euro payments to Bank Carribus of the interest and principal associated with the bond issue of Bridgerock in D that has an AIC of 13.80%.
- D. Bridgerock issues €100 million of bonds with 13.75% coupons. After fees of 2.25%, the company's AIC is 14.41%.
- E. Bridgerock gives the net proceeds of the debt, €97.75 million, to Bank Carribus in exchange for \$191.57 million, which is the present value at 9.60% of the dollar cash flows given in F. Bridgerock receives from Bank Carribus the euro interest and principal payments that it owes to bondholders in D.
- F. Bridgerock makes payments to Bank Carribus of the dollar payments of interest and principal with an AIC of 9.60% associated with the bond issue of Goodweek in A.

**Gains from swapping:**

## Funding Costs in Different Currencies

	Dollar	Euro
<b>Before the Swap</b>		
Goodweek	8.98%	14.16%
Bridgerock	9.99%	14.41%
Absolute Spread	101 bp	25 bp
Multiplicative Spread	93 bp	22 bp
<b>After the Swap</b>		
Goodweek	8.98%	13.80%
Bridgerock	9.60%	14.41%
Absolute Spread	62 bp	61 bp
Multiplicative Spread	57 bp	54 bp

*Notes:* AICs are reported for loans in dollars and euros before and after the swap. The absolute spread is the difference between the AIC of Bridgerock and the AIC of Goodweek. The multiplicative spread (mcsp) solves

$$(1 + \text{AIC}_{\text{Goodweek}})(1 + \text{mcsp}) = (1 + \text{AIC}_{\text{Bridgerock}})$$

## Swapping bond proceeds and coupon rates

### GOODWEEK'S DOLLAR BOND ISSUE AND CASH FLOWS IN THE SWAP INTO EUROS WITH BANK CARRIBUS

Year	Dollar Bond Issue	Swap Receipts (+) and Payments (-) with Bank Carribus			Extra Dollar Interest	Extra Euro Interest	Effective Euro Cash Flows
		Notional \$	Dollars	Notional €			
0	196.25	-200.00	-196.25	100.00			98.13
1	-17.00	16.50	17.00	-13.10	0.50	0.28	-13.38
2	-17.00	16.50	17.00	-13.10	0.50	0.28	-13.38
3	-17.00	16.50	17.00	-13.10	0.50	0.28	-13.38
4	-17.00	16.50	17.00	-13.10	0.50	0.28	-13.38
5	-217.00	216.50	217.00	-113.10	0.50	0.28	-113.38
AIC	8.98%	8.25%	8.98%	13.10%			13.93%

### BRIDGEROCK'S EURO BOND ISSUE AND SWAP INTO DOLLARS WITH BANK CARRIBUS

Year	Euro Bond Issue	Swap Receipts (+) and Payments (-) with Bank Carribus			Extra Euro Interest	Extra Dollar Interest	Effective Dollar Cash Flows
		Notional €	Euros	Notional \$			
0	97.75	-100.00	-97.75	200.00			195.50
1	-13.75	13.00	13.75	-16.70	0.75	1.33	-18.03
2	-13.75	13.00	13.75	-16.70	0.75	1.33	-18.03
3	-13.75	13.00	13.75	-16.70	0.75	1.33	-18.03
4	-13.75	13.00	13.75	-16.70	0.75	1.33	-18.03
5	-113.75	113.00	113.75	-216.70	0.75	1.33	-218.03
AIC	14.41%	13.00%	14.41%	8.35%			9.60%

**BANK CARRIBUS'S CASH FLOWS**

Year	Receipts (+) from Goodweek Payments (-) to Goodweek		Receipts (+) from Bridgerock Payments (-) to Bridgerock		Dollars	Euros
	Dollars	Euros	Dollars	Euros		
0	196.25	-98.13	-195.50	97.75	0.75	-0.38
1	-17.00	13.38	18.03	-13.75	1.03	-0.37
2	-17.00	13.38	18.03	-13.75	1.03	-0.37
3	-17.00	13.38	18.03	-13.75	1.03	-0.37
4	-17.00	13.38	18.03	-13.75	1.03	-0.37
5	-217.00	113.38	218.03	-113.75	1.03	-0.37
AIC	8.98%	13.93%	9.60%	14.41%		
				Present Value @	8.35%	13.00%
				Value in Dollars	4.84	-1.67
					1.50	

*Note:* All cash flows are in millions of dollars or euros.

- Currency swaps as a package of forward contracts
  - In the example, Goodweek and Bridgerock are essentially entering into a 5-year swap with same implicit forward exchange rate (for first 4 years – the last exchange has a different rate)
  - When interest rates differ across currencies, the implicit forward rates in the swap are very different from the long-term forward rate
  
- Euro bond issues with forward hedging
  - Goodweek and Bridgerock could exploit their comparative advantages in borrowing by issuing bonds in their comparatively low-cost currencies and using long-term forward contracts to hedge bond payments
    - Goodweek issues dollar bonds and contract to buy dollars with euros in the long-term forward market to cover the dollar interest and principal payments
    - Bridgerock could issue euro bonds and contract to sell dollars forward for euros in the long-term forward market to cover its euro interest and principal payments

Bond issues hedged in the forward market:

Year	Dollars/Euros			% Spread	Goodweek's Dollar Bond Hedged into Euros		Bridgerock's Euro Bond Hedged into Dollars	
	Bid	Midpoint	Ask		Dollars	Euros	Euros	Dollars
0	1.9998	2.0000	2.0002	0.02	196.25	98.12	97.75	195.48
1	1.9143	1.9160	1.9176	0.17	-17.00	-8.88	-13.75	-26.37
2	1.8316	1.8355	1.8393	0.42	-17.00	-9.28	-13.75	-25.29
3	1.7516	1.7583	1.7651	0.77	-17.00	-9.71	-13.75	-24.27
4	1.6742	1.6845	1.6947	1.22	-17.00	-10.15	-13.75	-23.30
5	1.5990	1.6137	1.6284	1.82	-217.00	-135.71	-113.75	-185.23
				AICs	8.98%	13.96%	14.41%	9.79%

- Notes: Midpoint forward prices are  $(\$/\text{€}) \times (1.0830/1.1305)^k$ , where  $k$  is the number of years in the future. Cash flows are in millions of dollars or euros. The % spread is  $100 \times (\text{Ask} - \text{Bid}) / [(\text{Ask} + \text{Bid})/2]$ .
- 

The value of a currency swap

- Begin as 0 NPV
- Over time, as interest rates and exchange rates change, a currency swap develops a positive value to one of the counterparties (and a negative to the other)
  - Market value of currency swap to Goodweek is:  $B(t, \$200M, 8.5\%) - [B(t, \text{€}100M, 13.38\%) * S(t, \$/\text{€})]$
- Value of the swap can change over time
  - Exchange rate
  - Interest rates for \$ and €

Valuing a swap to close our position:

### BRIDGEROCK'S EURO BOND ISSUE AND SWAP INTO DOLLARS WITH BANK CARRIBUS

#### Swap Receipts (+) and Payments (-) with Bank Carribus

Year	Euros	Dollars
2	13.75	-18.03
3	13.75	-18.03
4	13.75	-18.03
5	113.75	-218.03
	105.32	-206.72
	PV @ 12%	PV @ 8%

- Euro value of the Swap at USD2.25/EUR 13.44
- 
- 
- 
-

- The rationale for currency swaps
  - Low-transaction-cost instrument for changing the currency of denomination of debt financing
  - So popular due to the integration of the world's international financial system
  - Used to be driven by regulatory constraints and tax arbitrage opportunities
  - Differences in credit risk analysis allows for lowering the cost of debt using swaps
  - Regulations on types of debt instruments institutions can hold as well as accounting/tax differences has also contributed to popularity
  
- Why swaps and not forwards?
  - Long-dated forward markets are illiquid
    - Bid-ask spreads widen beyond a maturity of 1 year
  - Associated cash flows of swaps are just like bonds
  - They can easily be hedged in the bond market

## **Chapitre 8- purchasing power parity and real exchange rates:**

### The PPP

- A simple model of the determination of exchange rates
- Baseline forecast for predicting exchange rate
- Plays a fundamental role in corporate decision making
  - Location of plants
  - Pricing products
  - Hedging decisions
- Assessing cost of living decisions (or job opportunities?!)
  - Inflation/deflation
    - Inflation – when price level is rising
    - Deflation – when price level is falling
- The general idea of purchasing power
  - Nominal price – the monetary value
  - Price level – the nominal price level of a country's "basket of goods"
    - Weighted average of goods and services (i.e., we spend 1% of our income on shoes)
  - Purchasing power – inverse of price level

- Calculating the price level – cost of living

$$P(t, \$) = \sum_{i=1}^N w_i P(t, i, \$)$$

Calculating a price index – ratio of price levels at two different times

$$PI(t+k, \$) = \left( \frac{P(t+k, \$)}{P(t, \$)} \right) \times 100 = \frac{\sum_{i=1}^N w_i P(t+k, i, \$)}{\sum_{i=1}^N w_i P(t, i, \$)} \times 100$$

Price indexes for the G7

Year	United States	Canada	France	Germany	Italy	Japan	United Kingdom
1960	27.6	24.6	17.2	39.4	9.8	21.2	13.2
1970	36.1	32.3	25.2	50.9	14.0	36.9	19.6
1980	76.5	69.7	63.3	82.6	51.0	87.2	70.7
1985	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1990	121.4	124.1	116.3	107.7	131.2	107.0	133.4
1995	141.7	139.2	129.9	126.2	168.6	113.5	158.4
2000	159.0	150.0	138.0	133.9	188.3	115.2	179.9
2005	179.4	167.8	151.8	144.9	212.0	112.4	202.1
2008	197.8	179.0	161.1	154.5	227.8	114.3	219.3
2009	197.1	179.5	161.2	155.0	229.5	112.7	224.0
2010	199.3	181.1	162.6	155.8	231.3	111.7	228.2

Note: Data are from the Organization for Economic Cooperation and Development's Main Economic Indicators.

### Calculating annual inflation

$$\frac{PI(t+1)}{PI(t)} = \frac{P(t+1)}{P(t)} = [1 + \pi(t+1)]$$

where  $\pi(t+1) = (P(t+1) - P(t))/P(t)$

From Exhibit 8.1: Italy, 1990-1991

$((139.8/131.2) - 1) * 100 = 6.55\%$

### Calculating cumulative inflation

$$\left( \frac{PI(t + N)}{PI(t)} \right)^{1/N}$$

where N=last-base year

From Exhibit 8.1; U.S., 1985-2005

$(179.4/100)^{1/20} = 1.0297$  or compound annual rate of <3%

### Absolute Purchasing power parity:

- Internal purchasing power – the amount of goods and services that can be purchased with \$1 *in* the U.S.
  - If price level is \$15,000, what is purchasing power of \$1 mil?
  - $(1/\$15,000) * \$1 \text{ mil} = 66.67$  consumption bundles
- External purchasing power - the amount of goods and services that can be purchased with \$1 *outside* the U.S.
  - $(1/S(t, \$/X)) * 1/P(t, X)$
  - $\frac{\text{Pounds}}{\text{Dollar}} * \frac{\text{UK cons. bundles}}{\text{Pound}} = \frac{\text{UK cons. Bundles}}{\text{Dollar}}$

### Absolute Purchasing Power Parity

- States that the exchange rate adjusts to equalize the internal with external purchasing powers of a currency.

$$\frac{1}{P(t, \$)} = \frac{1}{S^{PPP}(t, \$ / X)} \times \frac{1}{P(t, X)}$$

- 
- What if it doesn't adjust? Then arbitrage is possible.
- Buy goods at cheaper price, ship them to where goods are more expensive and sell them (of course price difference would have to be great enough to cover transportation costs)

- Internal purchasing power of \$1M based on \$15,000 price level

- $\$1M * 1 / \$15,000 = 66.67$  cons. bundle
- External purchasing power of \$1M based on £10,000 price level
  - $\$1M * [1 / (\$1.4 / \pounds)] = \pounds 714,286$
  - $\pounds 714,286 * 1 / \pounds 10,000 = 71.43$  cons. bundle
- Because external PP > internal PP, one can profit from buying UK goods and shipping them to US for resale
  - Sell 71.43 cons. bundles (from UK) in US at \$15,000/cons. Bundle, we receive:  $\$1,071,450 = (71.43 * \$15,000)$

### **Overview-The law of one price:**

- The perfect market ideal
  - Big Mac should cost the same (once you convert money) no matter where you go
- Why violations of the law of one price occur
  - Tariffs and quotas – before 2003, Malaysia tariff up to 300%!
  - Transaction costs – would you go to Italy to get a haircut?
  - Difficulty in finding buyers for some goods
  - Noncompetitive markets
  - Sticky prices – sometimes there are costs for switching prices (“menu costs”)

### **Describing deviations from PPP:**

- Overvalued - when its external purchasing power exceeds its internal purchasing power
- Undervalued when its external purchasing power is less than its internal purchasing power
- Overvaluation of one currency implies undervaluation of the other currency in the exchange rate
  - Think taller/shorter – these are relative terms
- Predictions
  - Overvaluations – must weaken (depreciate)
  - Undervaluations – must strengthen (appreciate)

### **Overvaluation of the dollar implies undervaluation of the pound**

- Dollar (pound) price level is  $\$15,000 (\pounds 10,000) / \text{consumption bundle}$

- Exchange rate = \$1.40/£
- Overvaluation of dollar relative to the pound – the external purchasing power of the dollar > internal purchasing power

$\$1M * (\text{£}1/\$1.40) * (1/\text{£}10,000/\text{consumption bundle}) = 71.43$   
consumption bundles

$\$1M * (1 / \$15,000/\text{consumption bundle}) = 66.67$  consumption bundles

- Undervaluation of the pound relative to the dollar – internal purchasing power > external purchasing power

$\text{£}1M * (1/\text{£}10,000/\text{consumption bundle}) = 100$  consumption bundles

$\text{£}1M * (\$1.40/\text{£}1) * (1/\$15,000/\text{consumption bundle}) = 93.33$   
consumption bundles

### **Describing deviations from PPP:**

The MacPPP Standard

The Big Mac as a Price Index

- Advantages to use:
  - Standard product globally
  - Local suppliers used reducing transit costs
- Surprisingly close to more complicated indexes
- Implied MacPPP Rates
- Overvaluations/Undervaluations

		Big Mac Prices		Exchange Rates		% Under (-)/Over (+) Valuation against the Dollar
		Local Currency	Dollars	PPP	Actual	
United States <sup>a</sup>	dollar	3.58	3.58	1.00	1.00	
Australia	dollar	4.30	4.30	1.20	1.08	11%
Britain <sup>b</sup>	pound	2.27	3.48	1.58	1.53	-3%
Canada	dollar	4.10	4.06	1.14	1.01	13%
China	yuan	12.51	1.83	3.49	6.84	-49%
Egypt	pound	13.26	2.37	3.70	5.59	-34%
Euro area <sup>c</sup>	euro	3.48	4.62	1.03	1.33	29%
Hungary	forint	754.37	3.75	210.72	201.17	5%
Indonesia	rupiah	20,559.06	2.28	5,742.75	9,017.13	-36%
Japan	yen	333.40	3.54	93.13	94.18	-1%
Malaysia	ringgit	6.76	2.12	1.89	3.19	-41%
Mexico	peso	31.32	2.56	8.75	12.24	-28%
Norway	kroner	42.94	6.87	11.99	6.25	92%
Poland	zloty	8.42	2.86	2.35	2.95	-20%
Russia	ruble	69.78	2.39	19.49	29.19	-33%
Saudi Arabia	riyal	10.03	2.67	2.80	3.76	-25%
South Africa	rand	17.96	2.44	5.02	7.36	-32%
South Korea	won	3,330.75	3.00	930.38	1,110.25	-16%
Switzerland	franc	6.64	6.16	1.86	1.08	72%
Taiwan	dollar	73.97	2.36	20.66	31.35	-34%
Thailand	baht	70.12	2.16	19.59	32.46	-40%
Turkey	lire	5.51	3.71	1.54	1.49	4%
U.A.E.	dirham	10.98	2.99	3.07	3.67	-16%

<sup>a</sup>Average of New York, Chicago, San Francisco, and Atlanta.

<sup>b</sup>Exchange rate: dollars per pound.

<sup>c</sup>Weighted average of member countries. Exchange rate: dollars per euro.

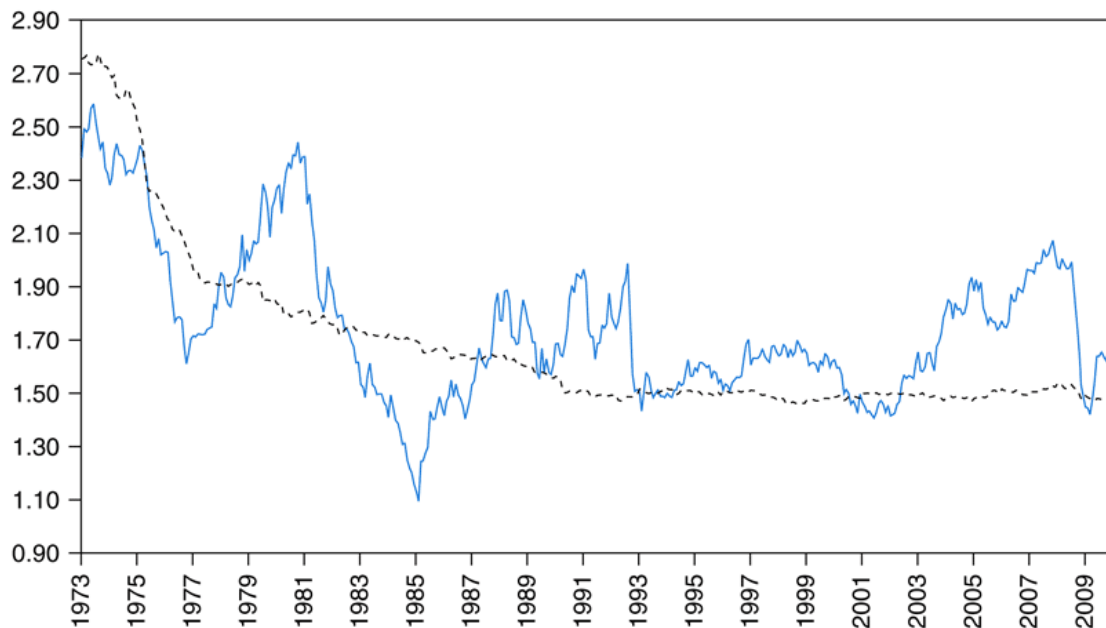
Note: Data are from *The Economist*, online edition, May 17, 2010, and author's calculations.

## Describing deviations:

- Some predictions of currency appreciations
  - Predicting British Heartburn in 1991
    - Pound set too high by ERM – *The Economist* suggested that they devalue it or they would be sorry
    - In 9/92, British authorities were forced to withdraw from ERM
    - Not before they lost \$12 billion trying to defend the higher rate!
  - Predicting initial weakness of the euro
    - Euro depreciated by 13% in 1999!
  - The econometric evidence
    - Several studies find that although there are deviations, they are temporary

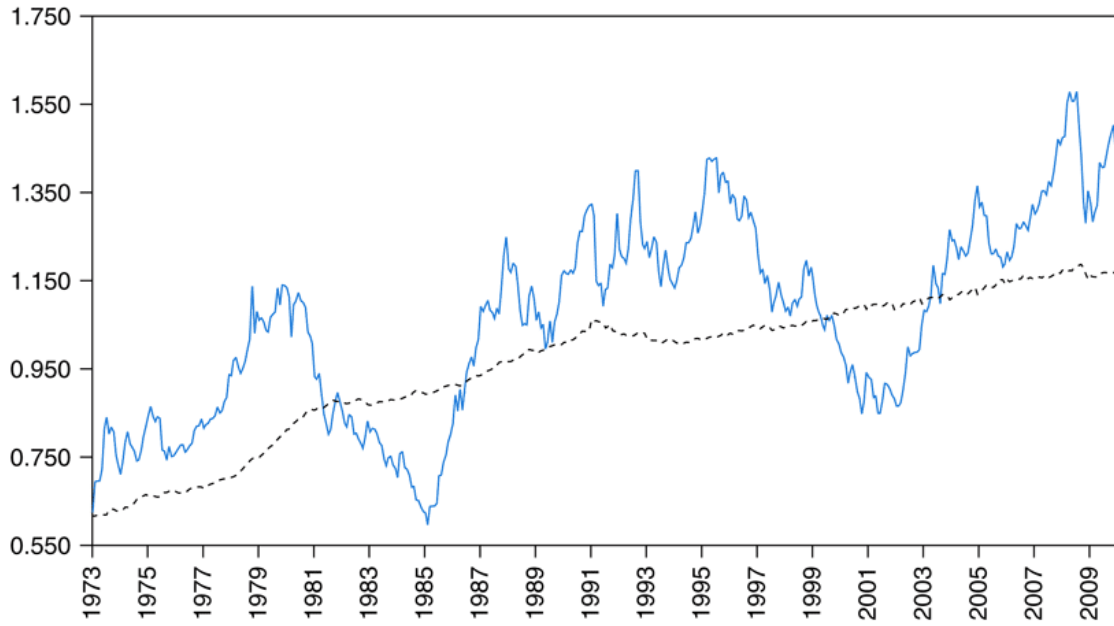
- A 10% undervalued currency tends to appreciate by 3.5% the next year
- Interpreting the charts
  - Overvaluations and undervaluations
    - Remember how exchange rate is quoted – the pound and euro are quoted directly as the amount of dollars it takes to purchase £1 or €1 whereas the other exchange rates (relative to the \$) are quoted indirectly as the amount of that currency it takes to purchase \$1
    - Dollar is undervalued when the actual exchange rate is above the PPP prediction
  - Fixing when PPP held

Actual USD/GBP and PPP exchange rates:



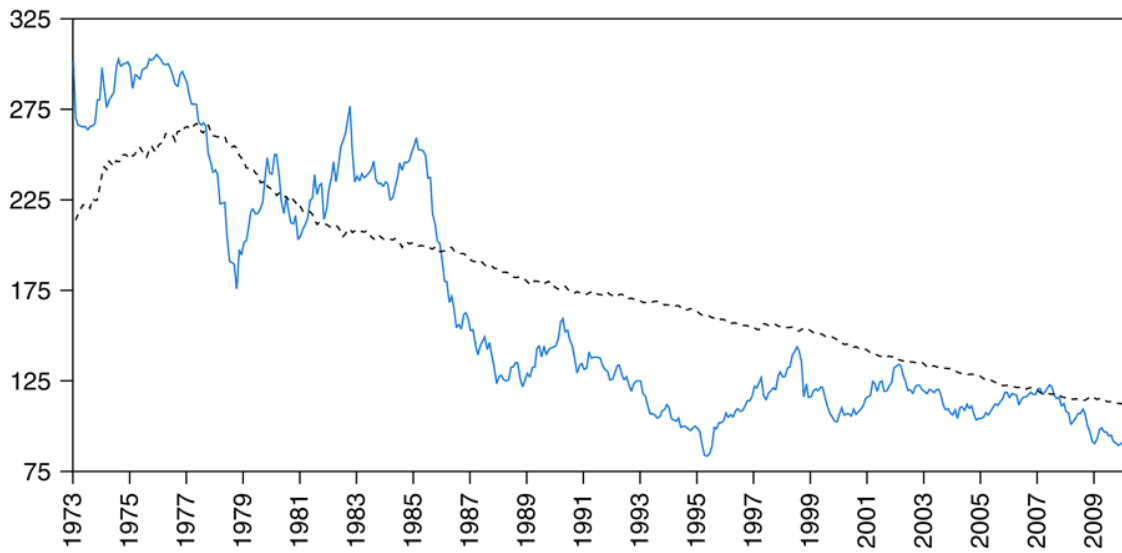
Notes: The solid line is the actual exchange rate, and the dashed line is the PPP rate. Data are from the International Monetary Fund's International Financial Statistics.

Actual USD/EUR and PPP exchange rates



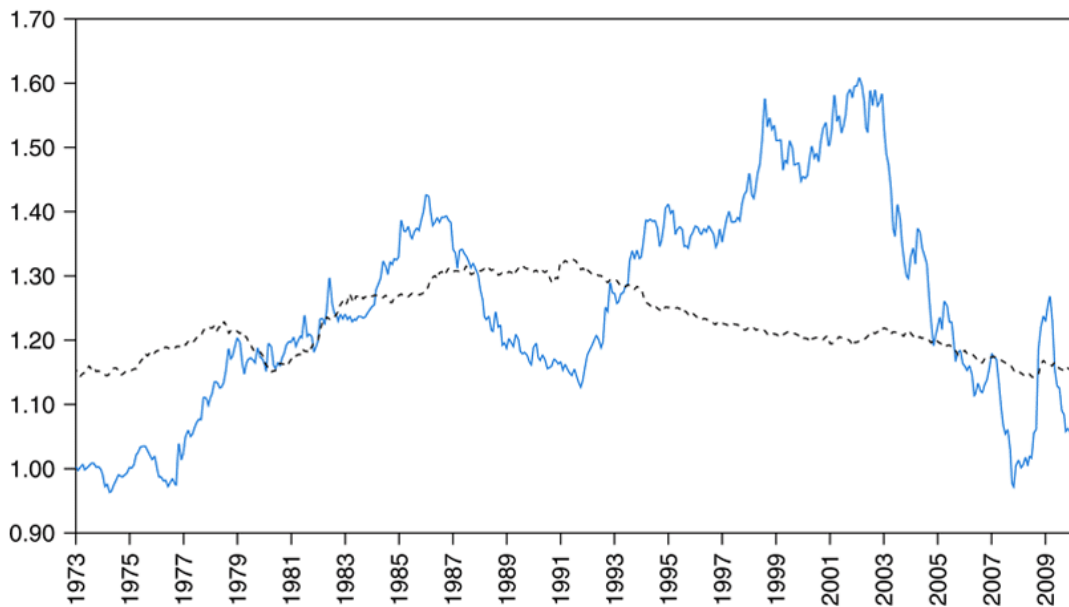
*Notes:* The solid line is the actual exchange rate, and the dashed line is the PPP rate. Data are from the International Monetary Fund's International Financial Statistics.

### Actual JPY/USD and PPP exchange rates:



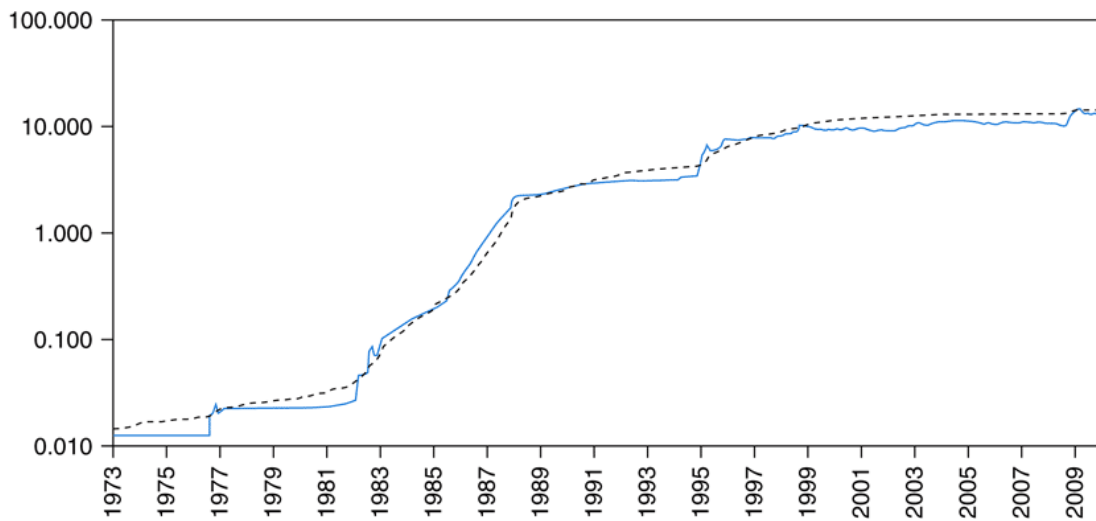
*Notes:* The solid line is the actual exchange rate, and the dashed line is the PPP rate. Data are from the International Monetary Fund's International Financial Statistics.

### Actual CAD/USD and PPP exchange rates:



Notes: The solid line is the actual exchange rate, and the dashed line is the PPP rate. Data are from the International Monetary Fund's International Financial Statistics.

### Actual MXN/USD and PPP exchange rates:



Notes: The solid line is the actual exchange rate, and the dashed line is the PPP rate. Data are from the International Monetary Fund's International Financial Statistics.

## **Explaining the failure of absolute PPP:**

### Overview

- Changes in relative prices – what if Japanese spend more on sushi than Americans do?
  - Different weights
- Non-traded goods
  - Houses
  - Technology/productivity improvements
- PPP deviations and the Balance of Payments
  - When a currency is overvalued (relative to that implied by the PPP), the external purchasing power increases and consumers buy more foreign goods, thus pulling the value of the domestic currency back down

### Comparing Incomes in New York and Tokyo

\$100,000 in NY versus \$150,000 in Tokyo

Incorporating purchasing power – you will be spending yen in Japan not \$'s so we need to look at this

$$\left( \frac{\$100,000}{P(t, \$)} \right) = \left( \frac{15,000,000 \text{ yen}}{P(t, \text{yen})} \right)$$

Working with the PPP rate – see how much NY job is worth in ¥

\$100,000 \* ¥160/\$ = ¥16,000,000

New York job is worth more

## **GDP per capita for OECD countries in 2008 using exchange rates and PPP values:**

OECD Country	In U.S. Dollars, Based on Market Exchange Rates	In U.S. Dollars, Based on PPP Exchange Rates
Australia	48,569	39,056
Austria	49,527	37,858
Belgium	47,151	35,288
Canada	44,995	39,014
Czech Republic	20,719	24,631
Denmark	62,054	36,808
Finland	50,775	35,809
France	44,450	33,098
Germany	44,519	35,432
Greece	31,174	28,896
Hungary	15,363	19,732
Iceland	52,610	36,994
Ireland	59,944	41,493
Italy	38,384	31,195
Japan	38,456	34,132
Korea	19,115	27,658
Luxembourg	117,967	84,713
Mexico	10,194	14,517
Netherlands	53,094	41,063
New Zealand	30,142	27,444
Norway	94,572	58,599
Poland	13,861	17,294
Portugal	22,951	23,283
Slovak Republic	17,537	22,141
Spain	34,971	31,455
Sweden	51,709	36,790
Switzerland	64,885	42,783
Turkey	10,275	13,959
United Kingdom	42,378	35,620
United States	47,186	47,186

- *Source:* Data are from the Organization for Economic Cooperation and Development's statistical database.

### Relative Purchasing Power Parity

- takes market imperfections into account
- Exchange rates adjust in response to differences in inflation across countries
- General expression for relative PPP

$$(1+ef) = (1+IU.S.)/(1+IU.K.)$$

- Logic is that inflation lowers the purchasing power of money. A change in the nominal exchange rate to compensate for different levels of inflation should occur

Suppose U.S. price level is \$15,000 and U.K.'s is £10,000;  $S = \$1.40/£$

- $\$15,000/£10,000 = \$1.50/£$  (PPP rate  $\neq$  actual forex rate)
- £ needs to strengthen by 7.14% ( $\$1.50/£ / \$1.40/£$ )

Now suppose  $I_{U.S.} = 3\%$  and  $I_{U.K.} = 10\%$ . U.S. price level goes to \$15,450 and U.K. price level goes to £11,000

- New implied PPP rate is  $\$15,450 / £11,000$  or  $\$1.4045/£$ 
  - This means it actually needs to weaken relative to the \$ for relative PPP to be satisfied
- If it devalues by 7.14% we have  $(\$1.4045/£)/1.0714 = \$1.3109/£$
- The actual forex rate changes by only  $(\$1.3109/£) / (\$1.40/£) = 0.9364 = 1 - 0.0636$  or 6.36%

This is also the ratio of  $(1 + I_{U.S.}) / (1 + I_{UK})$

- The definition of the real exchange rate – the exchange rate adjusted for inflation

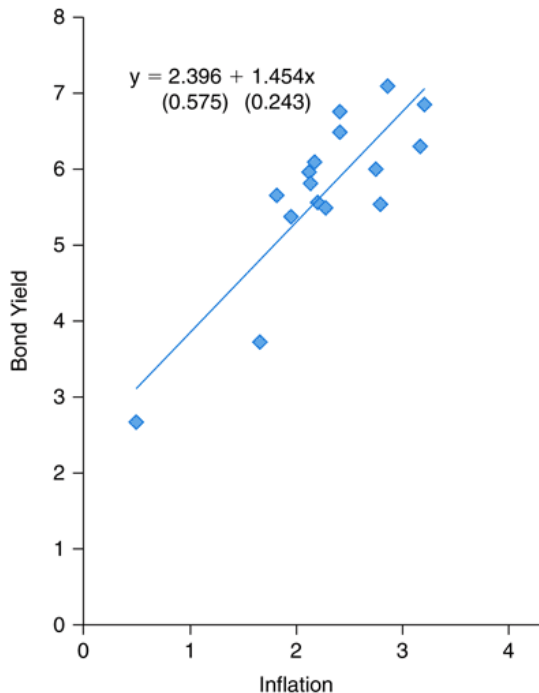
$$RS(t, \$ / euro) = \frac{S(t, \$ / euro) \times P(t, euro)}{P(t, \$)}$$

- Real appreciations and real depreciations – changes in forex rate adjusted for inflation
  - An increase in the nominal forex rate ( $\$/£$ ), holding \$ prices and £ prices constant
  - An increase in the £ prices of goods holding the \$ prices of goods constant
  - An increase in the \$ prices of goods holding the £ prices of goods constant
- Trade-weighted real exchange rates – useful when looking at how forex changes will affect trade balance

## **Chapter 10- Parity conditions and exchange rate forecasts**

- The Fisher Hypothesis
  - Interest rates and inflation
  - Real rates of return – measures how much your purchasing power has increased over time
  - The ex post real interest rate
    - $1 + r^{ep} = (1 + i) / (1 + \pi)$
    - Approximated by:  $r^{ep} = i - \pi$
  - The ex ante real interest rate

- Expected real interest rate
- Expected rate of inflation
- Fisher hypothesis – decomposition of nominal int. rates



*Notes:* The vertical axis measures average government bond yields for 1990–2010. The horizontal axis measures the average annual inflation rate over the same period. The diamonds represent 16 countries: Australia, Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Sweden, Switzerland, the United States, and the United Kingdom. The line represents a regression of yield ( $y$ ) on inflation ( $\pi$ ). The standard error of the estimate is between parentheses. Data are from the International Monetary Fund's International Financial Statistics.

## Parity conditions and exchange rate forecasts

- The International Parity Conditions
  - CIRP – Covered Interest Rate Parity
    - Links forward rates, spot rates, and interest rate differentials
  - UIRP or Unbiasedness – Uncovered Interest Rate Parity
    - Sometimes called International Fisher Effect/Relationship
    - Links expected exchange rate changes and interest rate differentials
  - PPP
    - Links inflation rates and rates of changes in forex rates

## International parity conditions- UK and CHF

Nominal Interest Rates:

U.K.:  $i^{\text{GBP}} = 5.00\%$ .

Switzerland:  $i^{\text{CHF}} = 3.00\%$

Exchange Rates:

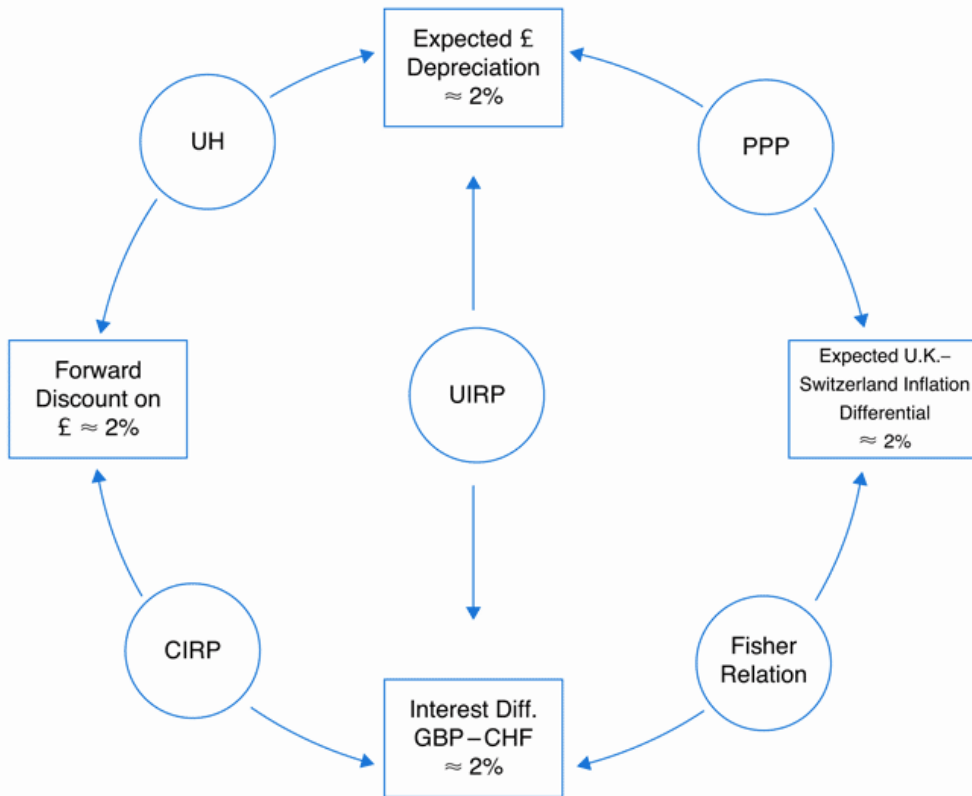
Spot Rate:  $S = \text{CHF}2.50/\text{GBP}$

Forward Rate:  $F = \text{CHF}2.4524/\text{GBP}$

Forward Premium :  $\left[ \frac{2.4524}{2.50} - 1 \right] = -1.90\%$

Expected Exchange Rate Change:  $-1.90\%$

Expected Inflation: U.K. =  $2.94\%$ ; Switzerland =  $0.98\%$



Notes: UH = unbiasedness hypothesis; PPP = purchasing power parity; CIRP = covered interest rate parity; UIRP = uncovered interest rate parity (international Fisher relation).

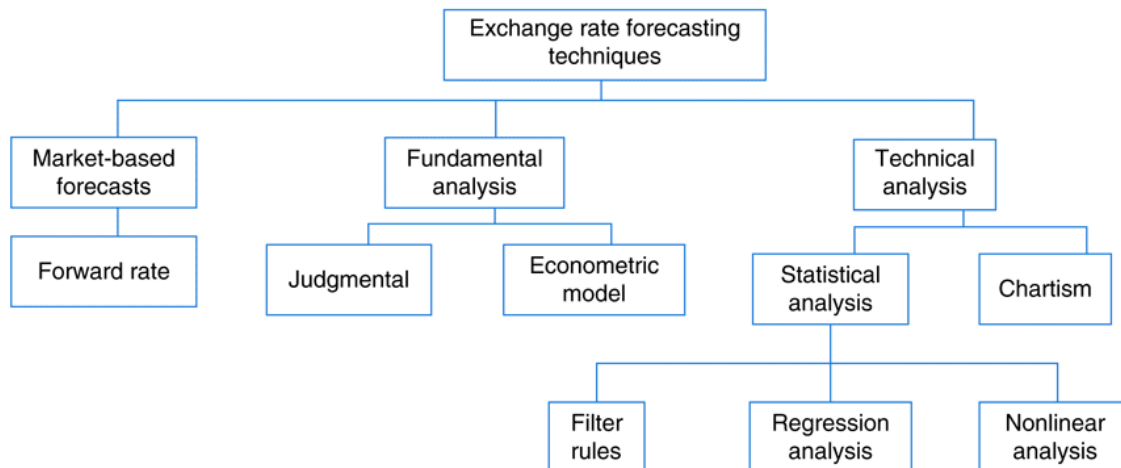
- International parity conditions
  - CIRP, UIRP (or Unbiasedness) and PPP
  - If they hold, real interest rates are the same every where
  - Empirical studies suggest that beyond IRP, none hold in either long- or short-run

- If International Fisher Relationship holds, the interest rates below would be equal – closer in long-run, but why not equal?
  - Significant deviations in PPP values
  - Returns in different currencies can have different risk premiums
  - Political risk and threat of capital control

**Currency forecasting technique:**

- Fundamental exchange rate forecasting
  - Uses fundamentals in econometric models (e.g., money supply, inflation, productivity growth rates, current account)
- Technical analysis
  - Using historical data to find patterns
  - Academics criticize but a survey suggests this is used often by traders so there might be something to it and other models have shortcomings so the verdict is still out
    - Fundamental analysis is flawed as well
    - Forward rate may not be an unbiased predictor of the future spot rate, even in an efficient market
    - If enough of the trading world uses it, it will matter through trade pressure.

Categories of exchange rate forecasting techniques



- Evaluating forecasts
  - Accuracy
    - Mean absolute error (MAE)
    - Root mean squared error (RMSE)
  - Being on the right side of the forward rate

- Making right decision as to whether to go long or short on currency could be sufficient
- Percentage correct – beat probability and statistics, i.e., 50% chance of being right
- Profitability – what if you're right only 30% of the time but you're right when it REALLY matters?

Fancy Foods can seek the advice of two forecasting companies to help it predict future forex rates: Forexia and Trompe Le Monde. Which forecast is more accurate?

	Forexia	Trompe Le Monde
Forecast	\$1.65/£	\$1.51/£
Forecast relative to forward rate (F: £1.53/\$)	Higher	Lower
Decision	Hedge	Do not hedge
Forecast error	-\$0.10/£	\$0.04/£
<i>Ex post</i> relative to forward rate	Zero	Positive

Technically more accurate but suggests no hedging, which proves to be costly:  
 $£1M * (\$1.55 - \$1.53)/£ = \$20,000$

More inaccurate but suggests hedging, which proves to be less costly

### Fundamental exchange rate forecasting:

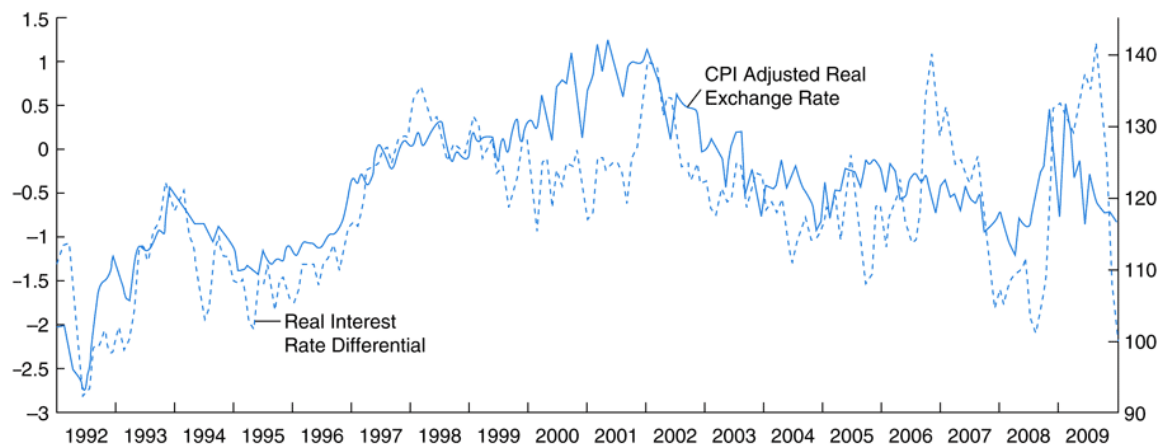
- The asset market approach to exchange rate determination
  - The exchange rate as an asset price – based on current fundamentals and expectations of future exchange rates
    - Just like stocks – linked to current/future fundamentals
    - Even a small change in current fundamentals can cause a large change in the forex rate if it also changes expectations

- The monetary approach
  - Real money balances – people are only concerned with the real value of the nominal money they are holding
    - Depends positively on income
    - Depends negatively on interest rates
    - Reasonable in the long-term, questionable in short-term (prices can be sticky)
  
- **Fundamental exchange rate forecasting:**
  
- Responses to an increase in the money supply
  - Prices – go up (long-run)
  - Interest rates
    - For the money market to remain in equilibrium, the demand for real balances must  $\uparrow$ 
      - If income (and therefore demand) can't adjust, interest rates are forced to – they decrease
      - Over time though they will rise again toward what they were
  - Exchange rate
    - $i_{\text{dom}} < i_{\text{for}}$  so according to UIRP (Intl Fisher Relation) domestic currency should appreciate
    - It should weaken in long-run, however.
  
- Why the random walk works
  - Current exchange rates adequately reflect the expected value of future fundamental values
    - In order for this to be true exchange rate should also predict future fundamental values (Engel, Mark and West, 2007 show this to be true)
  
- News and exchange rates
  - The performance of the monetary exchange rate model is that exchange rate changes are unpredictable but they still reflect news about fundamentals
  - News is incorporated into exchange rates very quickly (typically less than 15 minutes!)
    - Strange reaction to news about inflation/increases in money supply: the dollar appreciates whereas it should depreciate according to the MER model – one

interpretation is that this reaction anticipates central bank responses of aggressive monetary policies (i.e., higher interest rates)

- The real exchange rate and the real interest rate differential
- Converting UIRP (Intl Fisher Effect) to real terms
  - Alter nominal interest rates using expectation
  - When  $i_{for} > i_{dom}$ , domestic currency is expected to appreciate in real terms
  - Mean reversion – should always go back to the mean
    - Whether the forex rate is unusually high or low in forecasting future forex rates – your best predictor remains the CURRENT forex rate
- Empirical evidence - weak

### **The real exchange rate and the real interest differential**



*Notes:* The solid line is the real exchange rate calculated as an equally weighted average of the real exchange rates of 15 currencies versus the U.S. dollar using consumer price indexes (CPIs) as the price levels. The dotted line is the U.S. real interest rate minus the equally weighted average real interests of the 15 countries. The countries are Australia, Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Sweden, Switzerland, and the United Kingdom. Data are from the International Monetary Fund's International Financial Statistics.

- The real exchange rate and the BOP
  - The trade balance (part of the Current Account)- strong domestic currencies make foreign goods cheaper
  - The Capital Account – higher real interest rates (increase savings and decrease real investment) are associated with capital account deficits (losing net foreign investment)

- Equilibrium – supply and demand force an equilibrium price and quantity of the real exchange rate on the current account through a “goods” channel and a “savings and investment” channel
  - Increase in government spending/decrease in taxes causing a budget deficit increases demand → real interest rates increase → currency appreciates
  - New information signally increases in future GDP → consumers spend more → currency appreciates (due to Current Account deficit/inflow of foreign capital)
- PPP-based forecasts
  - Most popular fundamental exchange rate models
  - “Fair value” exchange rate models used by most brokers/banks
    - They adjust PPP for various effects, such as productivity trends, which is particularly important for developing countries
    - They use the deviation between current value and fair value of the exchange rate to predict the direction of change
  - Academic studies suggest there is some predictive power here, though limited to medium-to-long horizons
    - For example, Big Mac index.

current values along with historical impacts

$$e_t = a_0 + a_1 INT_t + a_2 INF_{t-1} + \mu_t$$

$a_0 = 0.001$ ;  $a_1 = -0.7$ ;  $a_2 = 0.6$ ;  $INF = 1\%$ ;  $INT$  – to be forecasted

Prob	Outcomes (INT)	Forecast (plug in numbers)
20%	-3%	$=0.001 + (-0.7)(-0.03) + (0.6)(0.01) = 0.028$
50%	-4%	$=0.001 + (-0.7)(-0.04) + (0.6)(0.01) = 0.035$

30%	-5%	$=0.001 + (-0.7)(-0.05) + (0.6)(0.01) = 0.042$
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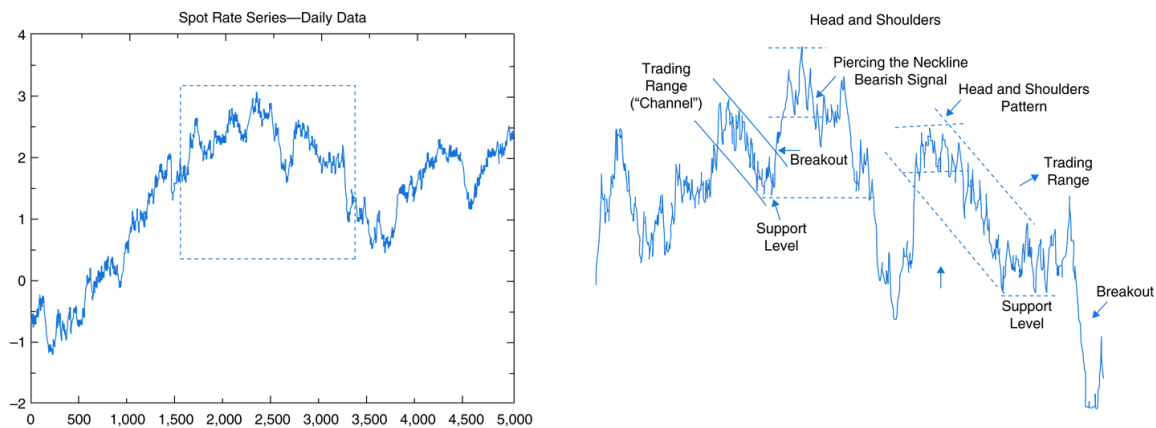
$$E(e_f) = (.20)(0.028) + (.50)(0.035) + (.30)(0.042)$$

$$= 0.0056 + 0.0175 + 0.0126 = 0.0357 \text{ or } 3.57\%$$

### Technical analysis:

- “Pure” technical analysis: chartism
  - Support level – level price has trouble falling below
  - Resistance level – level price has trouble rising above
  - Breakout – a sudden break of a trading range
  - Potentially spurious patterns
  - Trading on a random walk
  - Does charting work?

Exchange rate patterns described by chartists:

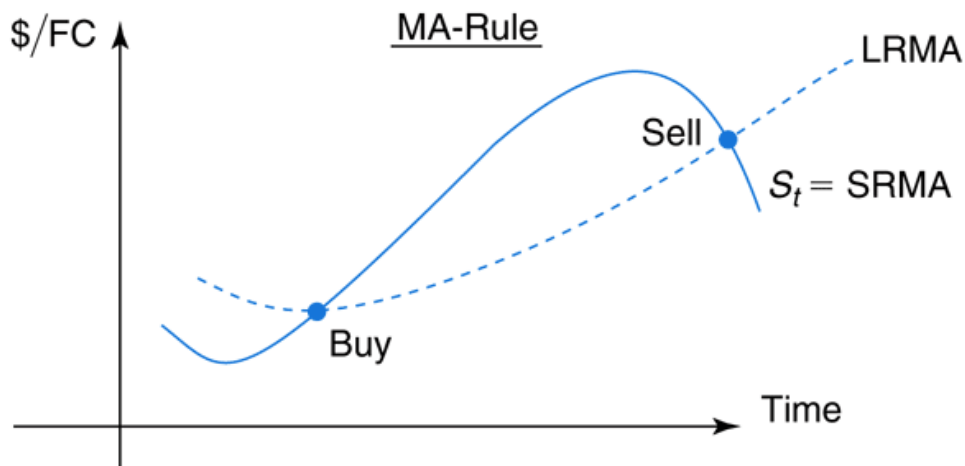


- Filter rules
  - x% rules – buy (go “long”) the currency if it appreciates by x% above its most recent trough (or support level) and sell (go “short”) the currency when it falls x% below its most recent peak (or resistance level)
  - Moving-average crossover rules – go long (short) in the foreign currency when the short-term moving average crosses the long-term moving average from below (above)

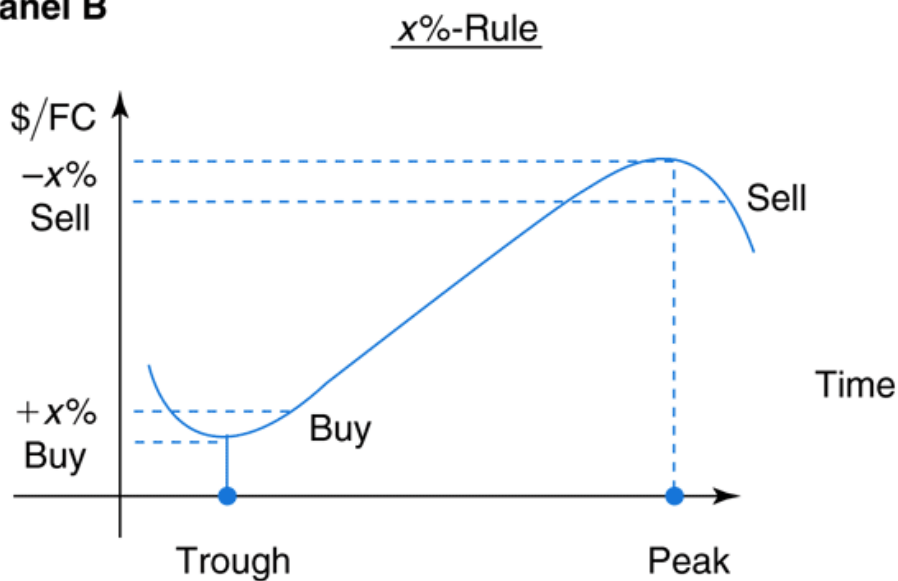
- 1 and 5 days; 1 and 20 days; 5 and 20 days
- Filter rule profitability – used to be profitable (i.e., 6.2%/year for Swiss franc and 13.94% for yen before 1994) but not so much any more. Since 2000, studies suggest using simple moving average rules works better
- Regression analysis
  - This framework is used each trading period to find a value for the expected forward market return – if the expected return is positive (negative), the strategy goes long (short) the foreign currency
- Non-linear models
  - More sophisticated models which take non-linearity into consideration
    - Use computer techniques such as algorithms to search for optimal trading rules.

How filter rules work:

**Panel A**



**Panel B**



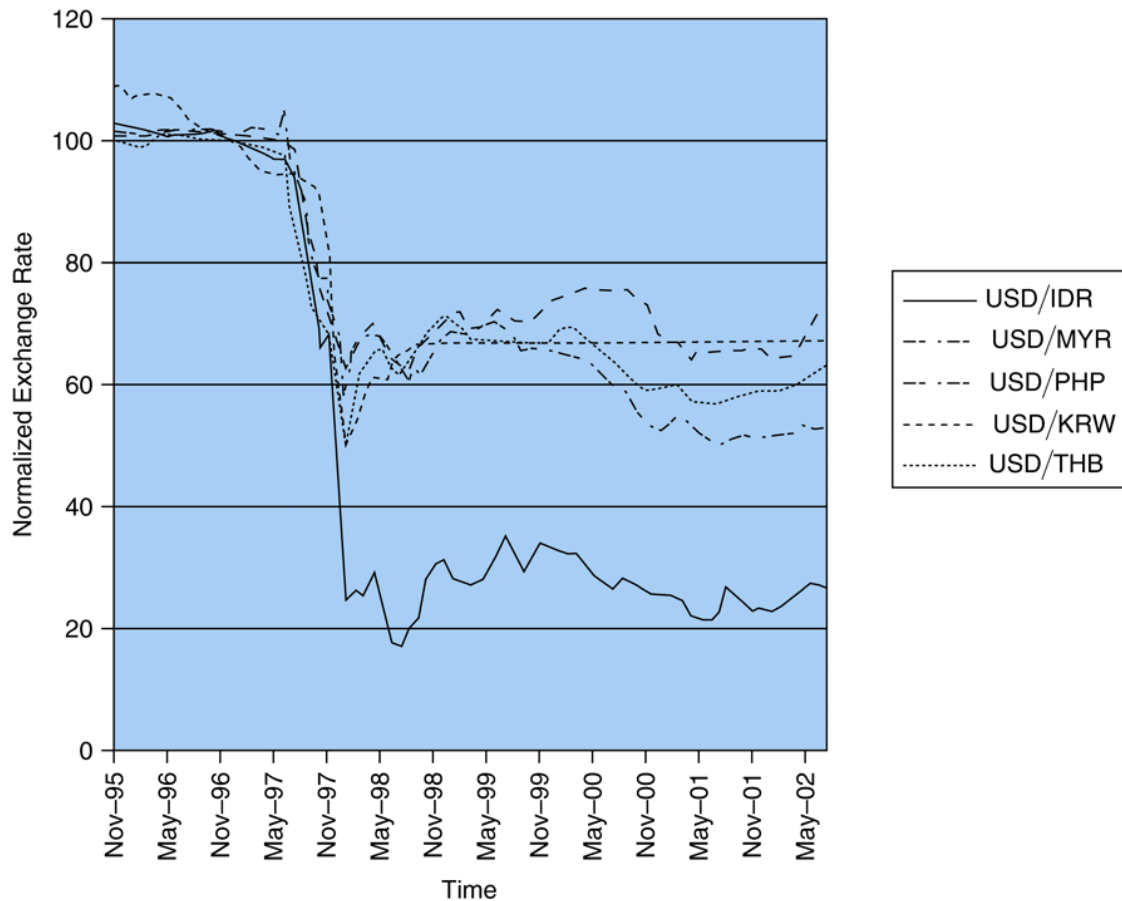
- Apply Darwinian-like, natural-selection process to filter rules on past data to breed the “best” trading rules
- What causes a currency crisis?
  - [The case of George Soros](#)
  - Macroeconomic conditions
    - Government follows policies inconsistent with its currency peg – speculative attack is unavoidable
      - Government will exhaust reserves defending peg
    - Growing budget deficits

- Fast money growth
- Rising wages and prices
- Currency overvaluation
- Current account deficits (caused by budget deficits combined with currency overvaluation)
  
- Self-fulfilling expectations
  - Group of investors begin speculative attack
  - Other investors see this and think that the currency will collapse so they convert out of currency
- Contagion
  - If group successfully attacks one currency, they might as well try another
  - If one currency is attacked, other currencies will appreciate relative to that currency and their domestic firms suffer a loss of competitiveness
  - Other countries in similar position – obvious targets (e.g., Asian crisis)
  
- Empirical evidence on the predictability of currency crisis
  - 1991-1992: Currency turmoil in Europe
  - 1994-1995: Mexican crisis and the Tequila effect
  - 1997: The Southeast Asian crisis

A rocky start to EMU:

**November 1991:** Devaluation of the Finnish markka relative to the ECU  
**December 1991:** Signing of the Maastricht Treaty  
**June 2, 1992:** Denmark referendum rejects Maastricht Treaty  
**September 8, 1992:** Finnish markka drops ECU peg  
**September 16, 1992:** Black Wednesday, British pound forced out of ERM  
**September 17, 1992:** Italian lira suspended from ERM; devaluations of Spanish peseta and Portuguese escudo  
**September 20, 1992:** French referendum (narrowly) accepts Maastricht Treaty; Spain reimposes previously lifted capital controls  
**November–December 1992:** Maastricht Treaty now ratified by all countries, except Britain and Denmark; Swedish and Norwegian kronor ECU pegs dropped; peseta and escudo further devalued  
**January 1993:** Devaluation of Irish punt  
**May 1993:** Peseta and escudo devalue once more; Danish referendum accepts Maastricht Treaty  
**July 1993:** Heavy speculative pressure against weak ERM currencies, including the French franc  
**August 1993:** Britain ratifies Maastricht; ERM bands widened to 15%  
**End of 1993:** Speculative pressures ease

### Asian exchange rates:



*Notes:* The exchange rates are normalized to equal 100 in January 1997. The currencies are the U.S. dollar values of the Indonesian rupiah (IDR), the Malaysian ringgit (MYR), the Philippine peso (PHP), the Korean won (KRW), and the Thai baht (THB).

### Zooropa in numbers:

Country	Currency's CRLS Position	Currency's Over/ Undervaluation %	Reserves, Import Coverage	Budget Deficit as % of GDP	Inflation Rate, %	GDP Growth, %
Sinead	-6	-10	9	-1.9	3.6	2.4
Carmen	-36	-12	3.1	-2.3	2.7	2.0
Marquee	16	11	8.2	-4.9	5.7	2.0
Fries	-3	11	11.7	-5.4	9.5	2.8
Ney	-22	-2	2.5	-2.1	2.2	2.1
Helpisink	31	-18	1.3	-5.5	2.1	1.6
Benfica	30	-16	1.5	-3.4	3.5	1.6
Che ora	-90	3	2.6	-4.6	3.6	-0.8
Vachement	27	2	0.5	-11.3	5.2	1.3

## Chapter 15- International capital budgeting

- Adjusted Net Present Value

- Discounted cash flows of the all-equity firm

Only incremental, after-tax cash flows (same currency!)

- Value of the financial side effects

Examples: costs of issuing securities; tax implications of financing; costs of financial distress (if applicable); subsidized financing from governments

- Value the growth options

For a movie, this would be a sequel

- Adjusted Net Present Value is the sum of these three things:

$$ANPV = NPV + NPVF + GO$$

*Decision: accept only (+) ANPV projects*

Suppose the Vincenzo Uno has a project with the following expected cash flows:

Annual revenue €1,000,000

Annual cost -600,000

Operating income 400,000

Corporate tax (.34 tax rate) 134,000

After-tax profits €264,000

If the discount rate for this project is 20%, the present value of these perpetual expected profits is as follows:

$$\frac{264,000}{1.20} + \frac{264,000}{1.20^2} + \frac{264,000}{1.20^3} + \frac{264,000}{1.20^4} + \dots = \frac{264,000}{0.20} = 1,320,000$$

Suppose that the initial investment required to generate these cash flows is

€1,350,000. Then, the NPV of this project to Vincenzo Uno is negative:  
 $€1,320,000 - €1,350,000 = -€30,000$   
Since it is negative, we would reject the project.

### Deriving the NPV of free cash flow:

- Incremental profits - flows that result from the project alone
  - Export cannibalization
- Revenues - forecasts depend on future economic environment
- Costs - measures cost of goods sold
- Depreciation – legal tax shield; subtracted out before taxes are calculated
- Capital expenses – m
- 
- oney spent on property, plant and equipment (PPE)
- Net working capital – inventory and cash on hand to run business

**Step 1.** Subtract costs from revenues:

$$\text{Revenue} - \text{Costs} = \text{Earnings before interest and taxes (EBIT)}$$

**Step 2.** Subtract taxes on earnings:

$$\text{EBIT} - \text{Taxes on EBIT} = \text{Net operating profit less adjusted taxes (NOPLAT)}$$

**Step 3.** Add back non-cash costs:

$$\text{NOPLAT} + \text{Accounting depreciation} = \text{Gross cash flow (GCF)}$$

**Step 4.** Subtract investments made to increase future profitability:

$$\text{GCF} - \text{Change in net working capital } (\Delta\text{NWC}) - \text{Capital expenditures (CAPX)} \\ = \text{Free cash flow (FCF)}$$

- Earnings Before Interest and Taxes (EBIT) - Pretax operating income without debt
- Net Operating Profit Less Adjusted Taxes (NOPLAT) - Equals EBIT minus taxes paid
- Gross Cash Flow - NOPLAT plus depreciation
  - CAPX is capital expenditures
    - Large in initial stages of project
    - Investment later when repairs become costly
- 
-

- Discounting Free Cash Flows

$$NPV(t) = \sum_{k=0}^{\infty} \frac{E_t[FCF(t+k)]}{(1+r)^k}$$

- $r$  = Discount rate and  $k$  = number of years beyond time  $t$
- Calculating the terminal value of a project
  - In theory, the all-equity firm will “live” forever
  - In time value of money terms, though, discounted value of really distant years  $\approx 0$
  - $TV(t) = TV(t+k)/(1+r)^k$  where  $k$  = the last year
  - This number is the last number in the above equation
- The costs of issuing securities
  - Monetary fee
  - Underwriting discount:
    - The spread between what the firm receives from issuing securities and what the public pays for the securities
- Lee, Lockhead, Ritter and Zhao (1996) find that the percentage cost decreases as the amount of money raised increases (i.e., there are economies of scale). In their sample, the monetary fee  $\approx 3.69\%$  and the discount  $\approx 7.31\%$

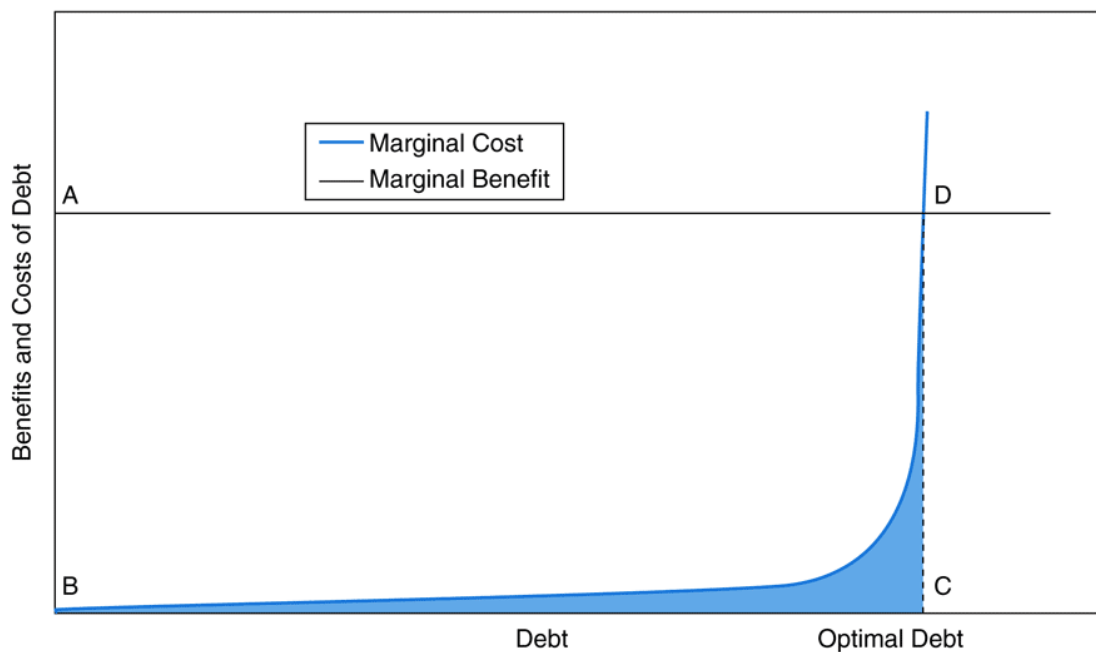
Financial side effects:

- Tax shields for certain securities
  - Interest tax shield - the value of the ability to deduct interest expense for tax purposes

$$D - \frac{(1+r_D)D}{(1+r_D)} + \frac{\tau r_D D}{(1+r_D)} = \frac{\tau r_D D}{(1+r_D)}$$

- For a perpetuity: this equation becomes  $tD$
- With a corporate tax rate of 34%, the value of Vincenzo Uno’s tax shield for a €500,000 issue of debt (8% interest rate) is:

- $0.34 * €500,000 = €170,000$
- The proper discount rate
  - Rate should reflect the appropriate riskiness of the project's cash flows
- Costs of financial distress
  - If these costs didn't exist, firms would have 100% debt in their capital structure
  - The direct costs of financial distress, e.g., legal consulting, and accounting fees  $\approx 3\%$
  - The indirect costs of financial distress – loss of value due to the expectation of failure
    - Customers not wanting to buy because they won't be able to get after-sales service or creditors unwilling to extend more credit
    - Inability to attract high-quality, skilled labor
- The equilibrium amount of debt: where the marginal benefit of the tax shield equals the marginal costs of financial distress.



*Note:* The rectangle ABCD is the total benefit of the debt. The shaded area under the marginal cost curve is the total cost of the debt.

-Marginal benefit is

Fixed (tax shield)  
 -Marginal  
 cost is not

- Subsidized financing
  - Interest subsidies
    - Add value to the project
    - Appropriate discount rate is the market’s required rate of return on the debt since the firm is just as likely to default on a subsidized loan
- Growth options arise when a firm undertakes a project and obtains an option to do another project in the future
  - Movie Sequel
  - Introduction of a domestic product internationally
- Also called “real options”
- Real-world example: Proctor & Gamble purchasing Brazilian company Phebo
  - Option value in learning about how to operate in Brazil (thus enabling them to expand further)

Vincenzo Uno’s forecast consists of two states for the first year: a good state or a bad state, where they will abandon project

- 50/50 shot at good/bad state
- State remains once it is realized (i.e., if it’s bad it stays bad)
- Abandonment option for bad state – scrap value of PP&E = €700,000
- Discount rate = 20%

	<u>Year 1</u>		<u>Future Years</u>	
	<b>Good State</b>	<b>Bad State</b>	<b>Good State</b>	<b>Bad State</b>
Annual cash inflows	€ 1,250,000	€ 750,000	€ 1,250,000	€ 0
Annual cash costs	-600,000	-600,000	-600,000	0
Operating income	650,000	150,000	650,000	0
Corporate tax (.34 tax rate)	-221,000	-51,000	-221,000	0
Unlevered free cash flow	€ 429,000	€ 99,000	€ 429,000	0

Good State Value  $€429,000 + €429,000/0.20 = €2,574,000$   
 Bad State Value  $€99,000 + €700,000 = €799,000$   
 Expectation (50/50 shot at good/bad)  $[0.5*(€2,574,000) + 0.5*(€799,000)]/1.20 = €1,405,417$   
 (which is more than the cost of the project)

### Growth options:

- Problems with the Discounted Cash Flow Approach (versus ANPV methodology)
  - Usually ignores real options
  - Especially option to enter another foreign market
    - Price changes
    - Changing real exchange rates
    - Timing of market entry (or exit)
    - Competition – do they also have an option of entering the same market? Is there a first-mover advantage?

### Parent versus subsidiary cash flows

- ANPV of parent versus Subsidiary – VERY different so you must be clear which one you are valuing
  - Foreign exchange controls, royalty payments, licensing agreements, overhead management fees, and profits from intermediate goods sold to subsidiary can make a huge difference
- A three-step approach to determining the value of a foreign subsidiary (i.e., from perspective of parent company)
  - Step One: NPV cash flow analysis on the foreign subsidiary as if it were independent of parent
  - Step Two: Cash flow from parent's perspective
    - After-withholding-tax dividends project will yield to parent
    - After-tax value of royalty payments, licensing/management fees, sales of intermediate goods
    - Watch for cannibalization of exports
  - Step Three: Adjust the value of the project for the NPV of financing side effects and possible growth options
- IWPI is considering whether to acquire a Spanish manufacturing facility to serve its European market
  - Initial Investments: €100M + €73M + €5.66M = €178.66M or \$250.12 M
  - Forecasting total revenue

- Only half of \$44,000 units demanded will be produced in Spain the 1<sup>st</sup> year but all thereafter
- Current price is \$3,430 (or at S= € 1.40/\$ → €2450) and will grow at expected inflation.

	Year in the Future									
	1	2	3	4	5	6	7	8	9	10
1. Real Growth Rates of Unit Sales	10%	11%	12%	10%	8%	6%	4%	3%	2%	1%
2. Unit Sales	22,000	48,840	54,701	60,171	64,985	68,884	71,639	73,788	75,264	76,017
3. Euro Inflation Rates	3%	4%	3%	2%	2%	2%	2%	2%	2%	2%
4. Euro Price per Unit	2,524	2,624	2,703	2,757	2,812	2,869	2,926	2,985	3,044	3,105
5. Total Euro Revenue (millions) (Line 2) × (Line 4)	55.52	128.18	147.87	165.91	182.76	197.60	209.62	220.22	229.12	236.04

- $\Delta NWC = NWC_t - NWC_{t-1}$
- CAPX: economic depreciation requires 3% replacement
  - CAPX will be  $(0.03 * 0.58) + (0.10 * 0.42)$  or 5.94% of initial CAPX for 1<sup>st</sup> year, or €10.28M
  - $CAPX_{t+k} = CAPX_{t+k-1} * (1 + \pi_{t+k}, \text{€})$
- $Depreciation_{t+k} = Depr_{t+k-1} + 0.0594 * CAPX_{t+k-1} \rightarrow$  straight line

### Forecasts of additions to net working capital and capital expenditures for IWSI-Spain.

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. Total Revenue (Exhibit 15.3, Line 5)		55.52	128.18	147.87	165.91	182.76	197.60	209.62	220.22	229.12	236.04
2. Stock of NWC (year 0 given, then 10.5% of Line 1)	5.66	5.83	13.46	15.53	17.42	19.19	20.75	22.01	23.12	24.06	24.78
3. Addition to NWC (Line 2 year $i$ – Line 2 year $(i-1)$ )		0.17	7.63	2.07	1.89	1.77	1.56	1.26	1.11	0.93	0.73
4. Capital Expenditures	173.00	10.58	11.01	11.34	11.56	11.80	12.03	12.27	12.52	12.77	13.02
5. Depreciation		10.28	10.90	11.56	12.23	12.92	13.62	14.33	15.06	15.81	16.57

Notes: All numbers are in millions of euros. Capital expenditures are the nominal spending necessary to keep the real capital stock constant.

### Cost forecasts for IWPI-SPAIN

	Year in the Future									
	1	2	3	4	5	6	7	8	9	10
1. Variable Cost per Unit										
a. Labor	702	730	752	767	782	798	814	830	847	864
b. Materials Sourced in Europe	665	692	712	727	741	756	771	786	802	818
c. Parts Purchased from IWPI-U.S.	407	423	436	445	454	463	472	481	491	501
2. Total Variable Cost (Lines 1.a + 1.b + 1.c) × (Exhibit 15.3, Line 2)	39.03	90.11	103.95	116.63	128.48	138.91	147.36	154.81	161.07	165.93
3. Royalty Fees @ 5% of Total Revenue (0.05 × Exhibit 15.3, Line 5)	2.78	6.41	7.39	8.30	9.14	9.88	10.48	11.01	11.46	11.80
4. Overhead Allocation @ 2% of Total Revenue (0.02 × Exhibit 15.3, Line 5)	1.11	2.56	2.96	3.32	3.66	3.95	4.19	4.40	4.58	4.72
5. Overhead Expenses	1.59	1.65	1.70	1.74	1.77	1.81	1.84	1.88	1.92	1.96
6. Depreciation (Exhibit 15.4, Line 5)	10.28	10.90	11.56	12.23	12.92	13.62	14.33	15.06	15.81	16.57
7. Total Cost (Lines 2 + 3 + 4 + 5 + 6)	54.78	111.64	127.56	142.21	155.96	168.17	178.21	187.17	194.83	200.98

Note: All numbers except the per-unit values in Line 1 are in millions of euros.

## The case of international wood products

- Royalty Fees – paid by subsidiary to parent
- Overhead allocation – paid to parent for help with accounting and management
- Variable costs and overhead expenses – increase @ € rate of inflation
  - U.S. costs are included here based on PPP

	Year in the Future									
	1	2	3	4	5	6	7	8	9	10
1. Total Revenue (Exhibit 15.3, Line 5)	55.52	123.18	147.87	165.91	182.76	197.60	209.62	220.22	229.12	236.04
2. Total Cost (Exhibit 15.5, Line 7)	54.78	111.64	127.56	142.21	155.96	168.17	178.21	187.17	194.33	200.98
3. Earnings Before Interest and Tax (EBIT) (Line 1 – Line 2)	0.74	16.54	20.30	23.69	26.80	29.43	31.41	33.05	34.29	35.06
4. Corporate Income Tax @ 35% (0.35 × Line 3)	0.26	5.79	7.11	8.29	9.38	10.30	10.99	11.57	12.00	12.27
5. Earnings After Tax (NOPLAT) (Line 3 – Line 4)	0.48	10.75	13.20	15.40	17.42	19.13	20.41	21.48	22.29	22.79

Note: All numbers are in millions of euros.

First two lines from previous exhibits NOPLAT follows from taking the difference between revenue and costs and subtracting taxes.

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. Earnings After Tax (NOPLAT) (Exhibit 15.6, Line 5)		0.48	10.75	13.20	15.40	17.42	19.13	20.41	21.48	22.29	22.79
2. Depreciation (Exhibit 15.4, Line 5)		10.28	10.90	11.56	12.23	12.92	13.62	14.33	15.06	15.81	16.57
3. Change in NWC (Exhibit 15.4, Line 3)		5.66	0.17	7.63	2.07	1.89	1.77	1.56	1.26	1.11	0.93
4. Capital Expenditures (CAPX) (Exhibit 15.4, Line 4)		173.00	10.58	11.01	11.34	11.56	11.80	12.03	12.27	12.52	12.77
5. Free Cash Flow (FCF) (Lines 1 + 2 - 3 - 4)		-178.66	0.00	3.02	11.35	14.17	16.77	19.16	21.21	22.91	24.39
6. Discount Factors (@ 11.1% per annum)		1.00	0.90	0.81	0.73	0.66	0.59	0.53	0.48	0.43	0.39
7. Present Value of FCF (Lines 5 × 6)		-178.66	0.00	2.45	8.28	9.30	9.91	10.19	10.15	9.87	9.46
8. Terminal Value		100.17									
9. NPV of the Project (sum of Line 7 + Line 8)		0.05									

Notes: All numbers except the discount factors are in millions of euros. The terminal value is the discounted value of free cash flow from years 11 to infinity, calculated as a perpetuity growing at the euro rate of inflation of 2%.

- Discount rate:
  - 4.5% (int. rate on German govt bonds) + [1.2 (beta) \* 5.5% (equity risk premium)] = 11.1%
    - Discount factor =  $1/(1+0.111)^k$
- Terminal value – discounted present value of all expected future free cash flows in years 11 and beyond
  1. Calculate the terminal value in the last year of the project as a growing perpetuity:
 
$$[(€25.6M) * (1+0.02)] / (0.111 - 0.02) = €286.95M$$
  1. Discount the terminal value from the terminal year to year 0:
 
$$€286.95M / (1+0.111)^{10} = €100.17M$$

- The Parent company's perspective
  - Forecasting the dividends received by IWPI-U.S.

	Year in the Future										
	1	2	3	4	5	6	7	8	9	10	
1. Dividend Paid to IWPI-U.S. (Exhibit 15.7, Line 5)	0.00	3.02	11.35	14.17	16.77	19.16	21.21	22.91	24.39	25.60	
2. Spanish Withholding Taxes @ 10% (0.10 × Line 1)	0.00	0.30	1.14	1.42	1.68	1.92	2.12	2.29	2.44	2.56	
3. After-Tax Dividend Rec'd by IWPI-U.S. (Line 1 - Line 2)	0.00	2.72	10.22	12.76	15.09	17.24	19.09	20.62	21.95	23.04	

Note: All numbers are in millions of euros.

- IWPI-Spain will pay all of its FCF to parent

- The parent will have to pay a 10% withholding tax to the Spanish government but they will get a tax credit from the U.S. government.

	Year in the Future									
	1	2	3	4	5	6	7	8	9	10
1. Dividend Paid to IWPI-U.S. (Exhibit 15.7, Line 5)	0.00	3.02	11.35	14.17	16.77	19.16	21.21	22.91	24.39	25.60
2. Spanish Withholding Taxes @ 10% (0.10 × Line 1)	0.00	0.30	1.14	1.42	1.68	1.92	2.12	2.29	2.44	2.56
3. After-Tax Dividend Rec'd by IWPI-U.S. (Line 1 – Line 2)	0.00	2.72	10.22	12.76	15.09	17.24	19.09	20.62	21.95	23.04

Note: All numbers are in millions of euros.

- If the ratio of the dividend paid by IWPI-Spain to the after-tax income of the subsidiary is <1 (i.e., if they don't send everything home), only a fraction of the income tax paid is allowed as a credit
  - E.g., Yr 1: €3.02M/ €10.75M \* €5.79 = €1.63M
  - The U.S. government realizes that only a fraction of the income earned was paid to the parent.

	Year in the Future									
	1	2	3	4	5	6	7	8	9	10
1. Net Income to IWPI-Spain (Exhibit 15.6, Line 5)	0.48	10.75	13.20	15.40	17.42	19.13	20.41	21.48	22.29	22.79
2. Dividend Paid by IWPI-Spain (Exhibit 15.8, Line 1)	0.00	3.02	11.35	14.17	16.77	19.16	21.21	22.91	24.39	25.60
3. Income Tax Paid by IWPI-Spain (Exhibit 15.6, Line 4)	0.26	5.79	7.11	8.29	9.38	10.30	10.99	11.57	12.00	12.27
4. Deemed Paid Credit to IWPI-U.S. for Income Taxes Paid by IWPI-Spain [(Line 2/ Line 1) × Line 3] if Line 2 < Line 1; Line 3, otherwise	0.00	1.63	6.11	7.63	9.03	10.30	10.99	11.57	12.00	12.27
5. Withholding Tax Paid (Exhibit 15.8, Line 2)	0.00	0.30	1.14	1.42	1.68	1.92	2.12	2.29	2.44	2.56
6. Total Foreign Tax Credit (Line 4 + Line 5)	0.00	1.93	7.25	9.05	10.71	12.22	13.11	13.86	14.44	14.83

Note: All numbers are in millions of euros.

- Grossed-up dividend: after-tax dividend + tax credit
- Potential U.S. tax on dividend:
  - $0.34 * €4.65M = €1.58M$
  - If this is less than the tax credit (1.93 in this case), U.S. taxes = 0

Calculation of U.S tax liability of IWPI-US

	Year in the Future									
	1	2	3	4	5	6	7	8	9	10
1. Grossed-up Foreign Dividend Received (Exhibit 15.8, Line 3 + Exhibit 15.9, Line 6)	0.00	4.64	17.46	21.81	25.80	29.46	32.21	34.48	36.39	37.88
2. Tentative U.S. Tax Liability @ 34% (0.34 × Line 1)	0.00	1.58	5.94	7.41	8.77	10.02	10.95	11.72	12.37	12.88
3. Available Foreign Tax Credit (Exhibit 15.9, Line 6)	0.00	1.93	7.25	9.05	10.71	12.22	13.11	13.86	14.44	14.83
4. Net U.S. Tax Owed (Line 2 – Line 3, if Line 2 > Line 3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Excess Foreign Tax Credit (Line 3 – Line 2, if Line 2 < Line 3)	0.00	0.35	1.31	1.64	1.94	2.20	2.16	2.13	2.07	1.95

Note: All numbers are in millions of euros.

## Net present value of after-tax dividends for IWPI-U.S

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. After Tax Value of Dividends to IWPI-U.S. (Exhibit 15.8, Line 3 – Exhibit 15.10, Line 4)		0.00	2.72	10.22	12.76	15.09	17.24	19.09	20.62	21.95	23.04
2. Discount Factors (@ 11.1% per annum)	1.00	0.90	0.81	0.73	0.66	0.59	0.53	0.48	0.43	0.39	0.35
3. Present Value of After-Tax Dividends (Line 1 × Line 2)		0.00	2.20	7.45	8.37	8.92	9.17	9.14	8.88	8.51	8.04
4. Terminal Value of Dividends	90.15										
5. NPV of After-Tax Dividends (sum of Line 3 + Line 4)	160.84										

Notes: All numbers except the discount factors are in millions of euros. The terminal value is the discounted value of dividends from years 11 to infinity, calculated as a perpetuity growing at the euro rate of inflation of 2%.

- Terminal value of dividends calculated in same way as other terminal value
- €160.84M < the cost of the project (Exhibit 15.11) of €178.66M  
BUT there are other sources of value
  - Royalty fees
  - Overhead allocation fees
  - After-tax profits of intermediate goods

Net present value of after tax royalty and overhead allocation fees received by IWPI-U.S

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. Royalty Fee @ 5% of Total Revenue (Exhibit 15.5, Line 3)		2.78	6.41	7.39	8.30	9.14	9.88	10.48	11.01	11.46	11.80
2. Spanish Withholding Tax @ 10% (0.10 × Line 1)		0.28	0.64	0.74	0.83	0.91	0.99	1.05	1.10	1.15	1.18
3. Overhead Fee @ 2% of Total Revenue (Exhibit 15.5, Line 4)		1.11	2.56	2.96	3.32	3.66	3.95	4.19	4.40	4.58	4.72
4. Spanish Withholding Taxes @ 14% (0.14 × Line 3)		0.16	0.36	0.41	0.46	0.51	0.55	0.59	0.62	0.64	0.66
5. After-Tax Fees Received by IWPI-U.S. (Line 1 – Line 2 + Line 3 – Line 4)		3.45	7.97	9.20	10.32	11.37	12.29	13.04	13.70	14.25	14.68
6. Tentative U.S. Tax Liability @ 34% (0.34 × (Line 1 + Line 3))		1.32	3.05	3.52	3.95	4.35	4.70	4.99	5.24	5.45	5.62
7. Excess Foreign Tax Credit from Dividends (Exhibit 15.10, Line 5)		0.00	0.35	1.31	1.64	1.94	2.20	2.16	2.13	2.07	1.95
8. Net U.S. Tax Owed (Line 6 – Line 2 – Line 4 – Line 7)		0.89	1.70	1.06	1.02	0.99	0.96	1.19	1.39	1.60	1.82
9. After-Tax Value of Fees to IWPI-U.S. (Line 5 – Line 8)		2.57	6.27	8.14	9.30	10.38	11.33	11.85	12.31	12.65	12.86
10. Discount Factors (@ 11.1% per annum)		0.90	0.81	0.73	0.66	0.59	0.53	0.48	0.43	0.39	0.35
11. Present Value of After-Tax Fees (Line 8 × Line 9)		2.31	5.08	5.94	6.10	6.13	6.02	5.67	5.30	4.91	4.49
12. Terminal Value of Fees	50.31										
13. NPV of After-Tax Fees (Sum of Line 11 + Line 12)	102.26										

Notes: All numbers except the discount factors are in millions of euros. The terminal value is the discounted value of fees from years 11 to infinity, calculated as a perpetuity growing at the euro rate of inflation of 2%.

### Exhibit 15.13 Net Present Value of After-tax Profit on Intermediate Goods Sold by IWPI-U.S. to IWPI-Spain

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. Unit Sales (Exhibit 15.3, Line 2)		22,000	48,840	54,701	60,171	64,985	68,884	71,639	73,788	75,264	76,017
2. Per-Unit Price of Exported Parts (Exhibit 15.5, Line 1.c)		407	423	436	445	454	463	472	481	491	501
3. Export Revenue of IWPI-U.S. (Line 1 × Line 2)		8.95	20.67	23.85	26.76	29.48	31.87	33.81	35.52	36.95	38.07
4. Before-Tax Profit @ 16% Margin (0.16 × Line 3)		1.43	3.31	3.82	4.28	4.72	5.10	5.41	5.68	5.91	6.09
5. U.S. Corporate Tax @ 34% (0.34 × Line 4)		0.49	1.12	1.30	1.46	1.60	1.73	1.84	1.93	2.01	2.07
6. After-Tax Profit (Line 4 – Line 5)		0.95	2.18	2.52	2.83	3.11	3.37	3.57	3.75	3.90	4.02
7. Discount Factors (@ 11.1% per annum)		0.90	0.81	0.73	0.66	0.59	0.53	0.48	0.43	0.39	0.35
8. Present Value of After-Tax Profits (Line 6 × Line 7)		0.85	1.77	1.84	1.85	1.84	1.79	1.71	1.62	1.51	1.40
9. Terminal Value of Profits	15.73										
10. NPV of After-Tax Profits (sum of Line 8 + Line 9)	31.91										

Notes: All numbers except Lines 1 and 2 and the discount factors are in millions of euros. The terminal value is the discounted value of profits from years 11 to infinity, calculated as a perpetuity growing at the euro rate of inflation of 2%.

- Valuing the Financial Side Effects
  - Subsidized loan by Spanish Government (€4M; 10 yrs; int. rate = 5%)

- Interest Tax Shields:  $0.35 * (0.03 * \text{€}30\text{M}) = \text{€}0.315\text{M}$

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. Tax Rate $\times$ Interest Paid		0.315	0.315	0.315	0.315	0.315	0.315	0.315	0.315	0.315	0.315
2. Discount Factors (@ 6.00% per annum)		0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56
3. Present Value of Interest Tax Shields (Line 1 $\times$ Line 2)		0.30	0.28	0.26	0.25	0.24	0.22	0.21	0.20	0.19	0.18
4. Terminal Value of Tax Shields	8.97										
5. NPV of Interest Tax Shields (sum of Line 3 + Line 4)	11.29										

Note: All numbers except the discount factors are in millions of euros.

Interest Subsidies:  $(0.06 * \text{€}30\text{M}) - \text{€}0.9\text{M} = \text{€}0.9\text{M}$

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. Interest Subsidy		0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
2. Discount Factors (@ 6.00% per annum)		0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56
3. Present Value of Interest Subsidy (Line 1 $\times$ Line 2)		0.85	0.80	0.76	0.71	0.67	0.63	0.60	0.56	0.53	0.50
4. NPV of Interest Subsidy (sum of Line 3)	6.62										

Note: All numbers except the discount factors are in millions of euros.

## NPV of interest tax shields

	Year in the Future										
	0	1	2	3	4	5	6	7	8	9	10
1. Unit Export Sales		18,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
2. Price per Unit (Exhibit 15.3, Line 4)		2,524	2,624	2,703	2,757	2,812	2,869	2,926	2,985	3,044	3,105
3. Export Revenue (Line 1 $\times$ Line 2)		45.42	104.98	108.13	110.29	112.50	114.75	117.04	119.38	121.77	124.20
4. Before-Tax Profit @ 18% Margin (0.16 $\times$ Line 3)		7.27	16.80	17.30	17.65	18.00	18.36	18.73	19.10	19.48	19.87
5. U.S. Corporate Tax @ 34% (0.34 $\times$ Line 4)		2.47	5.71	5.88	6.00	6.12	6.24	6.37	6.49	6.62	6.76
6. After-Tax Profit (Line 4 – Line 5)		4.80	11.09	11.42	11.65	11.88	12.12	12.36	12.61	12.86	13.12
7. Discount Factors (@ 11.1% per annum)		0.90	0.81	0.73	0.66	0.59	0.53	0.48	0.43	0.39	0.35
8. Present Value of After-Tax Profits (Line 6 $\times$ Line 7)		4.32	8.98	8.33	7.64	7.02	6.44	5.92	5.43	4.99	4.58
9. Terminal Value of Profits	51.31										
10. NPV of After-Tax Profits (sum of Line 8 + Line 9)	114.95										

Notes: All numbers except Lines 1 and 2 and the discount factors are in millions of euros. The Terminal Value is the discounted value of profits from years 11 to infinity calculated as a perpetuity growing at the euro rate of inflation of 2%.

The case of international wood products:

**ANPV of IWPI-Spain =**

**- €178.66M initial costs**

	+ €160.84M dividends
	+ €102.26M royalties
	+ €31.91M exports
	+ €11.29M interest tax sh
	+ €6.62M interest subsidy
	= €134.26M (or @ €1.40/ \$187.97M)
Decision	accept

- Cannibalization of export sales
  - Lost sales in first year are 18,000 (40,000 – 22,000 produced in Spanish facility)
  - ANPV falls because of this – (€134.26M - €114.95M) = €19.31M - but it's still positive so it does not impact the decision to accept the project